ENDEMIC FEVER IN LOWER BENGAL,

COMMONLY CALLED

"BURDWAN FEVER."

BY

SURGEON-MAJOR JOHN GAY FRENCH,
M.D. & F.R.C.S., LOND. (EXAM.)
FIRST RESIDENT SURGEON, GENERAL HOSPITAL, CALCUTTA;
LATE CIVIL SURGEON OF BURDWAN.

Now— Health Officer of the Port of Calcutta.

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Extract from letter No. 1218, *of* 25*th March* 1875, *from the Under-Secretary to Government of Bengal, to the Surgeon-General, Indian Medical Department.*

"The thanks of Government should be conveyed to Dr. French for his long and self denying labors in connection with the Burdwan Fever."

TRO
RAMC COLL.
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For Surgeon-General J. Fayrer C.S.I.
M.D. F.R.S.L. &c.
with
the Author's Compliments.

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In the thirty-second number of the "Indian Annals of Medical Science," January 1874, I gave a brief history of this fever down to October 1873. I recorded details of some cases, and added a few remarks on the causes, symptoms, types, and treatment of the disease. I shall now continue the history down to present time, with the particulars for the years, and then discuss the different questions and matters which have sprung up since my paper was written on 28th November 1873. At that time we had the fever raging in the town and suburbs of Burdwan: in the north-west, west, south, and centre of the district; slightly in the north (the worst places being Chanok and Mungulcote); south-east as at Jamalpore, Jowgram, &c., and not at all in the north-east or east, where it first broke out in the Burdwan district. We also saw that in 1873, it broke out for the first time at Mainapore, Hejulti, Lagura, Panuah, Baitah, Kushba, Deshra, in Kotulpore Thana (west of district), and in the south-west. In the first week in October, there was a very fatal type of remittent fever at Hajipur, near Jehanabad, where there had been a mild form of the disease in 1872. It did not, however, last long, and by the 20th of the month only ordinary cases of ague and remittent fever were met with.

Also in October fever broke out violently in Buddungunge, Thana Goghat, in the south-west of the district. In 1872 there had been a mild form of the disease prevailing in this village towards the end of the rains, but in 1873 the type was more severe or virulent. In Kalikapur, on the Adjye river in the north-west, in Gossainkando and other adjoining villages in Ausgram Thana, fever also broke out in October, but the type was ordinary, or that of simple malarious fever. In the latter week in October it appeared *for the first time,* but in a very mild form, in Mancoor station or village on the line of railway, and only 23 miles from Burdwan town. It also broke out in Kaksa and Paneeghur higher up the line. In the last fortnight in November sickness from fever was at its maximum, and from beginning of December it steadily abated. From the middle of November, there was no further outbreak in any village— The following table shows the daily average *actual* attendance at the Endemic Fever Dispensaries in each month in this year (1873). The figures are for *actual* daily attendance, and are exclusive of *absentees,* although their names were on the registers, and medicines for them may have been given to their friends on presentation of the tickets:—

Months.	Daily Average Attendance.	Months.	Daily Average Attendance.
January ...	6740·75	July ...	3793·85
February ...	6647·95	August ...	3619·40
March ...	5418·95	September ...	4049·13
April ...	5284·05	October ...	5178·40
May ...	4731·82	November ...	6240·15
June ...	4188·00	December ...	5992·23

The large attendance in the beginning of the year was owing to the chronic cases, and those of the sequelæ of the fever from previous years. The fever increase commenced in middle of August, and reached its maximum in middle of November.

Remarks on the fever of 1873.—In this year the fever was less prevalent, the type was milder than in 1872, and it was not nearly so fatal as in previous years. The fever which broke out for the first time in the west and south-west, I locally investigated, and there was no doubt about its being a purely malarious fever. Most of the inhabitants were laid up with ordinary ague, and a small proportion were suffering from remittent of varying degrees of severity from the mild to the fatal form. In the same village, and at the same time, all types could be seen, from the man shivering in the first stage of ague, to another dying in the coma of remittent. There were very few or hardly any cases of spleen among the children or adults. During the days that I spent in the villages in the west, the people abandoned work and business, and took to *poojahs* and offerings to the goddess.* The day and night were passed in processions and *tom-tomming.*† The outbreak, which had taken place amongst them, was exactly the same as had occurred in the villages to the eastward during the previous eleven years. In Mainapore the people told me that the disease had been introduced from Jehanabad, but on repeated house-to-house investigation I could not get the slightest proof of any case of contagion or infection. In Mancoor the outbreak consisted of merely an unusual number of agues, and in Kaksa and Paneeghur, with ordinary agues there were many cases of severe or bad remittent.

Fever in 1874.—The improvement (or abatement of fever admissions), which had set in from the last fortnight in November, continued up to the 25th January; but, after the rain on that date, there was a slight increase of fever of a mild type, and in some places fresh remittents were met with. In the first week in February there was again a decline, but in the second week there was a great increase. Aguish relapses were very common, and cases of new fever also came under treatment. Changes in the weather—rain, chills and heat alternating—were set down as exciting causes. Considerable sickness was reported from Paltia in the north, and an Endemic Dispensary had to be re-opened in that place. No change occurred in the third week in February, but in the last week there was again a decrease in the number of fever attacks. Not only did the numbers decrease, but also the type became less severe, and remittent fever cases disappeared in the station. Agues with or without spleen and chronic diseases formed the daily attendance, and the mortality, except in the far advanced cases, was *nil.* In the first week in March, remittents were met with in some parts, the greatest number being reported from the south-west of the district. Dr. G. C. Roy ascribed them "to fresh "liberation of malaria poison produced by the first turning of "the soil after it had in a manner settled down subsequent to "the reaping of the harvest." He further said :—"In none of "them was any typhus or typhoid symptom present, and the "type consisted of no other than malignant malarious remit- "tent." In the third week in March there was a further increase, and in the northern part of the district there were some fatal cases of remittent fever. This fatal type was not met with in other places, and the south-west began to improve. The general state of health of the people was more satisfactory than it had been in the corresponding period of 1873, or previous years. In the first week in April there was an improvement, but still remittents were daily treated in the country round Burdwan station, in the south-west, and south-south-west. In the last fortnight in April the first real improvement for the year set in: fever declined in most places, and nowhere was the dangerous type met with. Exactly the same state of affairs was observed in the corresponding period in 1873. The first fortnight in May was said by the Inspecting Medical Officers to be the most healthy that they had seen in Burdwan. In the more recently attacked places in the west of the district this improvement was most manifest, and the daily attendance at the Mainapore Dispensary went down to 30. Very rarely did the native doctors in their visiting rounds find bed-ridden patients. This improvement steadily continued throughout May, and caused that month to be considered the most healthy in the year. The daily sick attendance was now one-half of what it had been in December. Cholera, however, was at its maximum, and raging extensively. In the first fortnight in June there were atmospheric changes,—rain, chills and heat,—which were followed by relapses of ague in the old cases. At this time I inspected Cutwa, Bhediah, Boodbood, and Gulshi food relief depôts, and reported as follows:—

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* *Káli*—the Hecate of the Hindús.

† *Drum-beating.*

" It struck me that the appearance of the people has latterly " very much improved, and nowhere did I see the same suffer- " ing or the same number of broken down or emaciated cases " that I saw in previous years. Most of the children looked " healthy and plump, and the number of spleen cases appear to " be steadily decreasing. It is evident that, year by year, the " fever in the Burdwan district is gradually losing its virulence, " and is slowly dying out in many places."

In the second fortnight in June, particularly in the villages round Burdwan, in Khanoo, and part of the north of the district, there was a further increase in the number of aguish relapses. Although the number of fever cases increased, yet the daily average attendance at the dispensaries fell lower than at any other period in the year. This was accounted for by the agricultural pursuits of the people which at this time fully employed all those who were able to do any work. In the first fortnight in July the number of admissions from fever and the daily attendance began to increase, and remittents again came under treatment. Cases of this type were admitted into the Police Hospital, and were reported from the north and south of the district. In this fortnight the fever season of 1874 commenced in a very gradual and rather mild manner, but no regular or sudden outbreak occurred in any place. In the second fortnight a further general increase was observed, and the number of remittents exceeded that in previous fortnight. In the first fortnight in August the type became more severe, and the proportion of quotidian agues exceeded that observed during the dry hot months. The Europeans of both sexes resident in the station now began to suffer, and there was a considerable increase among the Police constables. In the second fortnight in August there was an improvement in the town, but none in the district, and it was observed that the proportion of remittents to total fever cases had increased. Assistant Surgeon Deenobundhu Dutt wrote:—"With few exceptions, ague has "increased in all my villages." Dr. G. C. Roy wrote:—"Cases "of remittent or continued fever have become of more frequent "occurrence, especially towards the west and at Kushba." On 21st it was found necessary to re-open the Endemic Fever Dispensary at Hajeepore in the south-east. In the first fortnight in September there was again a further and decided increase in the number of fever cases, particularly of old agues, but there was not a corresponding increase in the severity of the symptoms. The prevailing disease was a mild intermittent of the most ordinary type, and remittents were not so common as in previous fortnight. The reports from all the officers agreed in stating that "the present season has been much more healthy than the corresponding season in 1873." In the second fortnight in September, the prevalence of ague all over the district, and an increase in the number of fever cases were reported. Besides the intermittent cases, an increase of remittent fever was reported from all quarters, but particularly from the northern or Mungulcote circle. The increasing numbers gradually went on to the 16th of October (date of the cyclone), and it was also observed that during this time a greater number of persons were attacked for the first time than in the previous periods of the year. These new attacks were called cases of "fresh fever" by the Medical Officers. After the cyclone, there was a most notable increase of fever all over the district. With regard to the fresh cases, the increase was especially marked. The type of the great majority of cases, old and new, was intermittent, but in many places there was a considerable increase of remittent fever. After the cyclone no perceptible difference was observed amongst the Europeans in the station, the prisoners in the jail, or the Police Force.

In the district the increase was ascribed to—

(*a.*)—Recent development of malaria.
(*b.*)—Nervous depression of people from loss sustained.
(*c.*)—Privations, and exposure to cold and wet.

As all the small huts had been blown down by the cyclone, the people were obliged to sleep under trees and mats. The great increase in the number of cases of new or fresh fever pointed to the recent development of malaria. Buddungunge in the south-west suffered most severely.

Owing to the interruption of work in the dispensaries—most of them were blown down—and the occupation of the people in re-building their houses, inundations, &c., the daily average attendance for the week ending 21st October went down to 2821·4, but in the following week it rose to 5311·6.

During the first fortnight in November, fever continued to prevail extensively throughout the district, not only in the centre and western tract, but also in the eastern in which fever appeared to a greater extent than it had some years past. It was then reported that:—" On the whole, the fever is still mostly " of the intermittent type, but in some places large numbers of " remittent fevers have been observed. Fresh cases are very " numerous, and are still on the increase." As compared with previous fortnight, the number of admissions from fever increased by 2307. In the second fortnight in November the fever season of 1874 reached its maximum, and as compared with previous fortnight, the admissions from this disease alone increased by 3831, or 6138 since the beginning of the month. In November the most unhealthy week was that ending 30th. In this week the temperature rapidly and rather suddenly fell; the daily thermometric range began to rise; the atmosphere began to dry, and the subsoil water began to recede from the surface. Although these changes were temporarily observed in each month from the setting in of the rains, yet now only did we perceive the regular annual change. In 1872 and in 1873, the most unhealthy weeks were those ending 21st November. In 1871 the most unhealthy time was the first fortnight in December. In 1869 the maximum was in the end of November.

In the first fortnight in December the tide turned, and an improvement from the commencement of the month set in. The fever declined, both as regard the number of cases and the severity of the type. The fever admissions decreased by 7571 as compared with previous fortnight, and the improvement was so decided that, on the 31st, five out of the forty-seven dispensaries were closed. The same steady improvement was also observed in the corresponding period in previous years.

Returns for 1874.—The following statement shows the daily average *actual* attendance during each month in 1874:—

Months.	Daily Average Attendance.	Months.	Daily Average Attendance.
January ...	5643·5	July ...	3416·8
February ...	5611·6	August ...	3674·5
March ...	5258·4	September ...	4279·5
April ...	4208·1	October ...	4583·1
May ...	3662·8	November ...	5927·8
June ...	3143·8	December ...	5157·7

The following statement shows the admissions from fever and its *sequelæ* as spleen, anæmia, dropsy, anasarca, &c., in the three circles of the Burdwan district during each month in 1874:—

Months in 1874.	Burdwan Circle, Centre.			Jehanabad Circle, Southern.			Mungulcote Circle, Northern.		
	Admissions.			Admissions.			Admissions.		
	Fevers.	Spleen.	Dropsy, Anæmia, &c. &c.	Fevers.	Spleen.	Dropsy, Anæmia, &c. &c.	Fevers.	Spleen.	Dropsy, Anæmia, &c. &c.
January ...	8,925	7,019	441	17,629	8,414	833	8,435	4,986	499
February ...	7,442	6,178	329	20,002	7,368	843	6,309	4,276	331
March ...	7,437	6,122	332	18,442	7,668	833	6,395	4,948	358
April ...	8,202	4,495	387	11,899	5,819	560	5,722	4,363	367
May ...	7,767	5,320	337	9,911	5,789	476	4,971	3,710	333
June ...	6,242	4,245	261	9,844	5,173	416	4,069	3,472	262
July ...	8,905	4,564	357	9,966	4,498	506	5,203	2,906	435
August ...	9,958	4,084	372	9,599	4,214	504	6,570	2,797	517
September ...	15,710	4,326	399	9,910	5,116	479	9,266	2,670	494
October ...	14,723	5,054	452	14,131	7,116	620	13,213	3,387	337
November ...	25,849	5,395	552	18,135	9,851	523	16,129	4,144	317
December ...	14,258	5,785	447	14,968	8,818	558	9,432	4,334	310
Totals ...	135,418	61,586	4,666	160,917	79,844	7,151	95,714	45,893	4,550

Total for year ...... Fevers, 392,049. Spleen, 187,323. Dropsy, Anasarca, Anæmia, &c., 16,367.

Although June shows the best results in the foregoing tables, yet May was the most healthy month so far as fever was concerned. In this hot month, the people for the most part were lying idle waiting for the rains, and cases of different degrees of severity from the most trivial upwards presented themselves daily at the dispensaries. In June came the rains and the field labours of the agricultural classes, and now all who could, forgot their little ailments and kept away from the dispensaries. The healthy month of May very likely had also an effect in reducing sickness during June. Both tables show that November was the most unhealthy month.

The following table, compiled from the Police returns, shows the deaths from fever and its sequelæ in each month during 1874:—

Months.	Deaths.	Months.	Deaths.
January ...	1,411	July ...	645
February ...	1,311	August ...	863
March ...	1,336	September ...	776
April ...	953	October ...	725
May ...	825	November ...	1,409
June ...	636	December ...	1,298

The mortality in 1873 was much lower than it was in 1872, and in 1874 it was again much lower than in 1873. The fatal type of fever was not nearly so prevalent in 1874 as in previous years; and in nearly every village I was informed that comparatively few deaths from fever had occurred, and that the majority were from spleen, liver, dropsy, anasarca, &c., &c.

The fever in 1874 differed from that in 1873 and 1872 in the following points:

(*a.*) The fever in 1874 commenced earlier, more imperceptibly, and the progress was more gradual.

(*b.*) The type was much milder, and there were larger proportions of ague, and less of remittent fever.

(*c.*) The low or malignant remittent of previous years was rarely met with, and complicated fever was not so common.

(*d.*) The fever season was a little later in reaching its maximum.

(*e.*) The mortality was much lower than in previous years.

(*f.*) The sudden and severe outbreaks in villages of former years did not occur in 1874.

Meteorological Observations.—During the years 1873 and 1874, the latter particularly, I was very careful about the recording of the observations taken in the first class observatory in Burdwan. For the year, I drew out charts showing the courses, directions, variations, &c., which I do not consider necessary to reproduce here, but I will give the conclusions at which I arrived.

"In those months when the barometer is low and steady; "when the temperature is high or moderate; when the daily "thermometric range is at its maximum, or falling from that "maximum; when the humidity of the atmosphere is at its "lowest, or rising from its minimum; and when the subsoil "water is furthest from the surface,—fever is less prevalent, and "the type is milder.

"On the other hand, when the barometer is high, or rising "from a previously low state; when the temperature begins to "fall after heat; when the daily thermometric range is low, or "beginning to rise from its minimum; when the air begins to "dry rapidly, or when the humidity is high, and when the sub-"soil water is nearest to or receding from the surface,—fever is "at its maximum, and the type is severe or fatal."

In order to produce a fever of maximum intensity, the following conditions ought apparently to be associated:—

1*st.*—A saturated porous soil, or one retentive of moisture.

2*nd.*—A high subsoil water rapidly receding, as by a sudden fall in the drainage river.

3*rd.*—Heat of longer or shorter duration producing a drying atmosphere, rapid drying of the surface of the soil, and great evaporation.

These conditions thus associated will occur frequently, and at different times during the rainy season, and are best observed along the banks of high rivers and of obstructed *khals.**

The atmospheric conditions as given above for fever in Burdwan are reversed for cholera,—*i.e.*, when fever is at its maximum, cholera is at its minimum, and *vice versâ.* I do not wish or intend to dogmatically lay down these conditions as absolutely necessary for, or as being altogether the cause of fever. I give them as the result of my own observations, and with the hope that others will follow up the question.

Fever in current year since December.—With the exception of a slight rise or temporary increase of fever now and again, which in every year occurred in January, February, and March, the advancing improvement in the general state of health, which set in early in December last year, still continues, and may be expected to go on until next rains, when, as is common all over Bengal, we must expect an increase of fever.

Whether it be a bad or a good year, one of no outbreaks, or of sudden outbreaks and great mortality we cannot say, for we do not know what atmospheric changes may take place. Whatever has been and is the cause of the Burdwan fever (so far as we are concerned) still remains. Nothing has been done to remove it. If we judge from the course and progress of the fever during the past two years, we ought to be able to predict a favourable season; for all observations tended to show a reduced area, and a gradual loss in intensity or diminution in the virulence of the type. The fatal remittents have shown a tendency to die out; the severe remittents to become milder; the mild remittents to pass into quotidian agues, and these latter into tertian or quartan.

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* Small streams in India.

During the cold season the state of health of the villagers was so satisfactory, that I considered the time had come for a re-organisation of the relief measures; for a reduction in the number (46) of the dispensaries and medical officers (51), and for the withdrawal of Government from the whole of the expenditure. I may here state that exclusive of the salaries of medical officers, clerks, compounders, menial servants, contingencies, &c., the cost of the Burdwan medical store alone in 1874 amounted to Rs. 66,361, or about £6,636, of which the sum of Rs. 60,994, or £6,099, was for Europe medicines and instruments. Quinine and the Cinchona alkaloids alone cost Rs. 42,786, or about £4,278. From 4th August 1871 to 31st December 1874, the quantity of quinine and cinchona alkaloids issued from the Burdwan medical store, amounted to ℔s. 2,750·4 oz., at a cost of £13,476-4-5. During the same period the cost of all Europe medicines and hospital necessaries amounted to £20,864.

I proposed and carried out the following arrangements which were sanctioned by Government.

1*st.*—I reduced the number of fever dispensaries from 46 to 29, and made the villages, in which these were located, subscribe for all charges which had hitherto been borne by Government, with the exception of the salaries of the medical officers and the cost of Europe medicines. The saving to Government for six months on these 29 dispensaries only, I calculated at over Rs. 8,000, or £800.

2*nd.*—The subscriptions for six months in advance were lodged in the treasury before any dispensary was opened in the village, and payments from them commenced on 1st April 1875.

3*rd.*—The dispensaries were more centrally arranged so as to be within easy reach of the more unhealthy villages.

4*th.*—The Burdwan medical store was shut up, and each dispensary was supplied with medicines sufficient for six months. As before, quinine in solution is served out, according to requirements, from the Burdwan Government dispensary.

5th.—In addition to the 29 dispensary medical officers, a reserve staff of five men was kept in the district so as to provide for emergencies.

The services of one inspecting medical officer and 17 executive medical officers were dispensed with.

Having now brought down the history of this fever to the present time, and detailed the measures adopted to check it, with the exception of some observations on the nature and types of the disease, causes, &c., I should have nothing more to say were it not that Surgeon Major C. J. Jackson, M.D., late Sanitary Commissioner for Bengal, in his office report for 1873, brought out a most elaborate, able, and painstaking report on this fever, which will well repay perusal, and which I hope my readers will read for themselves. As his views and conclusions are opposed to mine, I must go as fully into his report as time and space will permit. In order to do so, I must write —as briefly as I can—a *resumé* of the progress of the fever throughout the Burdwan district from its first commencement, and then take up a consideration of the questions at issue, and those other difficult ones which are daily asked us. From personal observation, I know well that Dr. Jackson spared neither trouble, risk, nor labor in travelling about the district and investigating with great ability—as his report shows—the causes, &c., of this fever.

I certainly do feel diffidence in putting forward my opinions in opposition to those of so earnest and clear an observer, were it not that I plainly see that Dr. Jackson has formed his conclusions from *dry weather* tours or observations, and that he had not time to visit many of the most important places in the district.

While Civil Surgeon of Burdwan I visited every part of the district, and from 1st July to 30th November 1874, while specially employed on famine duty and in inspecting the 130 food depôts and suffering localities, I may say I lived in the mofussil villages. For one two or three days a mud hut sufficed for my abode, and then, instead of following only roads and tracks, my course generally lay across country in an irregular sort of line. Travelling in this way, I, at the same time carried on my investigations concerning the fever, and performed my famine relief duty. Any one who wishes to investigate the causes of this fever ought to live in the district *during the rains,* and not during the cold weather. Throughout the whole of Bengal I do not think there is a district like Burdwan in the rains. High grounds and low grounds; big rivers rising and falling suddenly and rapidly, at one time receiving all the water from the district, at another pouring an enormous quantity all over it; *khals* in some places running like sluice gates —at one time towards the big river, and at another in exactly the opposite direction; villages under water, or surrounded by immense inundation lakes, and others on high ground, are every where met with. In the dry season we can form no conception of the state of a village for some time, or at different times during the rains. Villages that had been under water, or surrounded by inundation water up to the very doors, may then appear to be on high dry land. *Khals,* deep and swift which really drained the country, or others that flowed backwards from pressure at their outlets and in opposition to the drainage of the tract, will be then nearly dry, if not quite so; while a sluggish and partly silted *nullah,* which was of no use in the rains, may contain water and appear efficient. In the rains also we can find out those roads which are shut up, and have all traffic along them stopped for some months in the year, and those which remain open throughout the whole twelve months—a most important observation as we shall see hereafter.

In para. 389, page 81, Part II, Dr. Jackson writes :—" It will " be seen from the foregoing remarks that while I believe the " fever to be malarious in origin, and to have some malarious " characteristics, I also believe it to be not a *mere* or simple, " but a contagious malarious fever; that it is probably typho-

"malarial; and that it has not been produced in Burdwan, but 'imported, and again carried from Burdwan into Beerbhoom, and that its behaviour under the various conditions observed "is quite incompatible with its being simply malarious, locally "produced, or non-contagious."

In sub-para. 4, para. 381, page 80, he also writes:—" It "travels, and not in the direction of the prevailing wind, but "of the traffic lines. Its first march in Burdwan was west- "ward; in the north its march was arrested by nullahs too "narrow to stop malaria, so far as we know, by absence of "intercourse and scanty population."

As I now go along in the following *resumé* I shall discuss these three questions:—

(*a.*) Is or was the fever contagious?

(*b.*) Did it travel along the main roads and traffic lines?

(*c.*) If not, how did it travel?

Resumé, showing Progress of the Fever.

In the rains in 1862 the disease first appeared in the Burdwan district in the villages in the Purbustholi Thana on the right bank of the Bhaugiruttee river. In the same year it attacked Pundooah (Hooghly district) on the Grand Trunk Road, and to the south-east of the Burdwan district. If we go back a few years, we find that in 1859 it was in Kanchrapara and in Nyhatti, opposite to Chinsurah. In 1860 it was in Baraset, in Rajahati in the 24-Pergunnahs, and in Trebani in the Hooghly district. In 1861 it was at Balagurh. In 1862 we have it at Gooptipara and Purbustholi, and in 1863 at Culna. In these years the fever raged chiefly on both sides of the Hooghly river; was very severe in the vicinity of such large towns as Barrackpore, Chandernagore, and other populous places which have never been attacked, *and instead of following the trade routes to Calcutta, struck off to the north and north-west.* Would a contagious fever have pursued this course? Nyhatti, opposite

Chinsurah, is only 25 miles, and Baraset only 15 miles from Calcutta. Some say that the villages in Culna Thana, close to the river, were first attacked, and subsequently those in Purbustholi Thana. From a petition from the Purbustholi villagers, we know that they had unusual sickness from fever in 1862. The difference is, however, not of much importance, for in either case we find the fever chiefly along the river. 1862 was an unusually wet year (105·87 inches, average for ten years = 56·10 inches), and I believe there was a general extension all along up the right bank to Purbustholi. In the villages in the Nuddea district, opposite Culna, fever had been raging for some time, but in those to the north opposite to Purbustholi, there was hardly any of it. There is one important fact which deserves notice. We have the disease raging in Pundooah on the Grand Trunk Road, and line of railway in 1862. This was evidently an extension from the river on the east. Now a contagious fever in Pundooah would have gone up and down this main road and along its feeders. Mymaree, ten miles off, would have been attacked before 1867, and Burdwan before 1868 or 1869. It would also have gone down the road, were it not that evidently it had always a perpetual dread of Calcutta. At Pundooah it had a grand field for extension, but of which it did not avail itself. In 1863 we find it raging in the villages along the right bank of the Bhaugiruttee from Purbustholi to the south of Culna Thana. As I said before, my own belief is that the extension was upward along the river; but as at this distant date we cannot ascertain the truth, and as Dr. Jackson maintains that it extended to Culna from Purbustholi along the traffic road between these two places, I will assume that it did first break out in Purbustholi, and afterwards in Culna. To the north of Purbustholi, the fever extended for a few miles only. There is a road leading from Cutwa in the north, through Purbustholi, and down to Culna. As far as Purbustholi the road is bad, but from that place to Culna it is a good road in the dry season. During the rainy months, or for nearly half the year the road is nearly impassable, and no trade is carried on along it. Down from Moorshedabad, from Cutwa to Purbustholi and Culna, the trade route is the river, and boats are the means of communication. I examined the places along the river during the rains, and found the roads nearly shut up, and all trade on them stopped. At this time of the year, the dry weather bad road from Cutwa to Purbustholi is just as good as the dry weather good road from the latter to Culna. I was able, though with difficulty, to march my horse and servants during the rains along the whole road. What I maintain then is that from Purbustholi to Cutwa and up the river, there is as much trade and intercommunication during the rains and fever season, as there is from Purbustholi to Culna. If then the fever had been contagious and had spread by contagion to Culna, or from Nuddea to Culna, it most certainly ought to have also extended up the river to Cutwa. I shall however hereafter be able to show that Cutwa—the populous and extensive mart at the junction of the Adjye and Bhaugiruttee rivers, and only 20 miles from Purbustholi—has never suffered from the *jwor-behar,** or dangerous form of the Burdwan fever. That it did not do so, is I consider one of the greatest proofs we can bring against the contagion theory. We must bear in mind that in the dry and hot season when the roads were open, and traffic along them carried on, *the fever died out.* From Purbustholi to Burdwan town we have a road,—a bad one I allow, but still it is a road—and as the villagers in that outpost or thana have to transact their official and other business, as Court appeals, &c., in Burdwan, they must come along it. I may here state that in the height of the rains, messengers came to me in Purbustholi along this road. If the fever raging in Purbustholi in 1863 had been contagious, it ought to have come some way at least--if not into Burdwan—along this road. But it never did, and this road passes through a remarkably healthy part of the district. In 1863 we have the fever raging from a little above Purbustholi, along the river, at Culna, Pundooah, and villages to the east near the river bank. Had it been contagious, it ought to have gone along the main roads from Culna to Burdwan, Culna to Mymaree, and Culna to Pundooah. The latter is the traffic line, but no fever appeared along it. In 1864 it spread further to the north of Purbustholi, and inland from the river for a few miles. In 1865 (villagers say after cyclone of 1864) it attacked village Ghose near Mymaree, skipping over many very populous villages along the road. In 1864 and 1865 the fever abated in Culna, but in 1866 it again broke out. In the rains of 1866 it goes south to Katalgatcha, Mohesdanga, and Oolora, the latter 4 miles from Mymaree. Further on in the season it remembers that it had spared the large town of Satgatchia on the main road, and goes back to attack it, and at the same time it spreads in the villges in Gangooria Thana near Mymaree. In the rains of 1867 it again goes back along the road (by which it is said it had come) leading from Culna to Burdwan, and attacks the large village of Bohar and other places that it passed over in 1864 or 1865. Now having got to Satgatchia and Mymaree, it leaves the Burdwan and Grand Trunk roads alone, and strikes down south to Kolingram, Jowgram, Abujhatti (villages away from roads) in Selimabad Thana. Quite regardless of roads it also makes a wide skip across country, and appears, though in a mild form, in Mahatta, Ramchunderpore, Radhanugur, Nurpur, and other villages in Thana Sahibgunge, and in Darshini, Pulsonar, and other places in Mungulcote Thana. In the end of the year some of it appears in Gangpore village within 5 miles of Burdwan, after having passed over all the villages intervening between that place and Mymaree. In this year it began to abate in the villages in the Purbustholi Thana and along the river, but in and near to Mymaree the mortality was frightful. In 1868 we find that it still kept away from the main road from Satgatchia to Burdwan, and that it showed itself in the suburbs of Burdwan by an unusual number of ague cases. At the same time, and in the same manner, it appeared in Shunamukhi far away to the west. There was also "unusual sickness in "Cutwa and Mungulcote, but it was in no way contagious; "was simply of malarious origin, and such as generally breaks "out after the cessation of the rains and commencement of the "cold season." In November it disappeared from Cutwa, and there had been no mortality. In Mungulcote it was virulent, and more fever cases than usual were observed on the right bank of the Damoodah in Shadipore, Jote Seram, Srekristopore, &c. In the villages on the left bank in Thana Selimabad, and in Thana Gangooria, it was particularly severe. Taken altogether 1868 was a mild year, and except in the case of Burdwan town the fever kept away from roads. In the rains in 1869 it again broke out in Thanas Gangooria, Selimabad, Sahibgunge, and Mungulcote. It broke out with violence in the suburbs and town of Burdwan, and was more decided in the villages along the right bank of the Damoodah, extending inland to Royna, Narigram, Indas, and other villages. We now find it on the Dalkissur river in the south, from Bamooneah to Jehanabad. It is reported that the Jehanabad attack was an extension from Hooghly along the Benares road, but investigation does not confirm this view; for the villages along the road from Jehanabad to the Hooghly district, and those to the eastward of that place, were not attacked until *after* Jehanabad. The outbreak was apparently a simultaneous one with that which had occurred along the right bank of the Damoodah river. From Jehanabad the disease did not extend along the Burdwan or Bancoorah roads, but it did along the Dalkissur river. It did not extend from the Damoodah river, for the villages and country between it and Jehanabad were not affected in this year. Going up north from Selimabad Thana, we find it attacking Bamneah and other villages along the Damoodah. Eastward from Burdwan on the Cutwa road, it attacked Koochoot. Had the disease come along the road from Culna, this place ought to have been attacked before Burdwan. Between Burdwan and Koochoot there was no fever, so that it was not probably an extension from Burdwan town. Dr. Jackson believes that Burdwan town acted as a centre from which the disease spread.* In para. 386, page 81, he writes :—" Its rapid " spread, after it appeared in Burdwan town, is, to my mind, " very significant. Not many people from Burdwan visit the " villages, but numbers of people from every part of the " district visit Burdwan, which is the focus of trade. No sooner " is the disease established in Burdwan, than it begins to appear " in every part of the district, north, south, east, and west— " north to Mungulcote and Cutwa; west to Galshee, Kanoo, " Chansik; south, overlapping the Damoodah into the Royna " and Khundghose Thanas, and eastward among villages near the " Damoodah left bank lying between it and the source from " which it was itself infected." In 1868 when the disease appeared in Burdwan as simply an exaggeration of the number of ordinary ague cases, it could not have been contagious. Now in that year we find the same disease in Cutwa and Mungulcote in the north; in Shunamukhi in the west; and in the south along the Damoodah and Dalkissur rivers. Clearly it did not extend to any of these places from Burdwan, and I have before shown that it did not come to Burdwan town along either the Grand Trunk or Culna roads. It did not extend to Koochoot from Burdwan as I have stated above. In the account for 1867, I showed that the disease appeared to the north (Sahibgunge Thana, and villages in Mungulcote Thana) of Burdwan town *one year before it attacked Burdwan.* In 1869 we do not find any trace of the fever along the Burdwan and Purbustholi road, but we meet with it in Soosoonah and other villages inland in the Muntessur Thana, and to the north of this road. Taking the main roads from Burdwan to Cutwa or Moorshedabad, and from Burdwan to Soorie, we find that in 1869 *no fever extended along them,* but it broke out in Baghar, Mahachanda, Mohunpore, Jeharah, and other villages *inland* and between these two roads. *The large villages along these roads were not attacked until* 1871 *or* 1872. North of Mungulcote we have it in 1868 along the Adjye from Shambazar within six miles of Cutwa. In this year we find no extension at all to the west of Burdwan town, or along the Grand Trunk (or high) road of the district. To sum up for 1869, we must come to the conclusion that there was no extension from Burdwan town, or along roads, but that there was along the rivers and *khals.*

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* The meaning of the word "jwor" or "jur" is *fever*, and that of "bekar" or "bikar," *unusual* or *extraordinary*. The term means, *an extraordinary or unusual fever*.

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* When a person or new-comer went into the malaria-producing tract or fever area, he was nearly certain to be attacked. But this was not contagion.

1870.—During the rains in this year we find in the north of the district the fever extending further to the westward along the Adjye river to the north of Chanoke. It leaves the area round Cutwa quite free. From this northern line we find it extending downwards towards the Cutwa road and attacking Koichur, Negun, and Bhaturi, &c. From Muntessur Thana or the eastward tract, it advances also towards the Cutwa road, and attacks Hargram, Nasseegram, and adjoining villages. Further south of this, from Bellunda to Burdwan along the Cutwa road, there is *no extension.* The Burdwan and Purbustholi road, and the Burdwan and Culna road as far as Koochoot, remain free from fever. Going back to the north, but more to the west, we find that it crosses the country and Gooshkara road and attacks Koormah in Ausgram Thana. From this going south towards Burdwan, we find that Ausgram is attacked, which is evidently an extension from the Mohunpore outbreak in previous year. Westward of Burdwan town we see Khanoo* (on the line of railway and 8 miles from the station) attacked, while the villages along the Grand Trunk Road, except Ooroo, 2½ miles from Khanoo, remain healthy. Going up along the line of railway it reaches Kolekole, and extends slightly inland towards Sur, &c. From Burdwan it now spreads upwards along both banks of the Damoodah—along the left bank to Kushba, and the right bank to Shongshur and Tassoolee. Between the Damoodah and the line of railway it avoids the whole of the inlying villages near the Grand Trunk Road, except Khanoo and Ooroo. A contagious fever raging in Burdwan in 1869 would have spread like wild fire up this travellers', pilgrims', and great traffic road, but the Burdwan fever never had a liking for the Grand Trunk Road. South of the Damoodah it extends down to the villages in Khundghose Thana, and joins the Royna and Indas extension of 1869 from the Damoodah on the east. From Khundghose along the road to Shunamukhi there is no fever. Going further south we find no extension westward from Indas. Further south still, we cannot trace any extension from Jehanabad along the roads to Burdwan, Bancoorah, or Midnapore, but there is an extension south along the Dalkissur to villages beyond Bally. Myapore, Gotan, Arooi, and other villages between the Damoodah and Jehanabad were this year attacked for the first time, which further goes to show that the disease did not travel westward along the old Benares road to Jehanabad. It appeared in Jehanabad before it broke out in Kistonugur, Doorhatta, Hurripal, Shooakatta, and other villages along this road in the Serampore sub-division. Jehanabad was also said to have acted as a centre from which the disease spread along the roads. The Civil Surgeon of Serampore in his report for 1873 thus wrote:—" The fever seems to follow the tracks of the " main and branch roads of the district originating at Jehanabad " on the other side of the Damoodah; the disease can be " distinctly traced along the old Benares road, which ends at " Sulkea above Howrah. There is no doubt the fever has been " carried along this road to Howrah." We thus see that first of all this unfortunate road is accused of having brought the fever from Hooghly to Jehanabad, and secondly, years afterwards, it is again accused of having brought it back from Jehanabad to Howrah. We find that the disease had been previously raging along this road, between the villages I have named above and Howrah, and long before it ever appeared in Jehanabad. In 1868 or 1869 it could not have jumped across country to Jehanabad, and then back again in 1870 and 1871. Had it been a contagious fever, Howrah, and in fact all the big villages along the road and Hooghly river to Calcutta, would have been decimated before it could appear in Jehanabad. Here again, in another part of Bengal, it refused to visit Calcutta, when, with a high way open, it could easily have done so. These places were south of the fever area, and therefore escaped. All these years, the people engaged in boat traffic between Moorshedabad, Cutwa, Purbustholi, or Culna, and the villages on the left bank of the Bhaugiruttee never brought the disease back to their homes in their own villages.

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* The reason why Khanoo suffered so early and so severely is clearly owing to the bad drainage in the place. The water is pent up between the railway on the north, and the Grand Trunk Road on the south. Many villages along the railway, and along the Damoodah and Adjye embankments, suffered from the same cause.

1871.—This year the whole of the country south of Burdwan town was overrun with fever, but still there was no extension along the roads from Khundghose to Shunamukhi, from Jehanabad to Bancoorah, or Jehanabad to Midnapore, or to the west of Indas Thana. It was very bad along the Dalkissur, south to Desspore Thana, and Nowada on the Cossye river in the Midnapore district. Four miles south of the road from Khundghose to Shunamukhi, there was an outbreak at Kistonugur, but there was none to the north of or along the road. From Shunamukhi there was a very slight extension to the north to Palishgram, some miles away from the main road to Kaksa, but none along the road. In the Boodbood Thana the villages that were attacked this year were to the south-east of that station towards and along the Damoodah, but it did not extend to Boodbood itself, or Mancoor. Between the Bodhye *khal* and the Dalkissur, a country traversed by the main road from Burdwan, there was no fever (except at Kistonugur), but between the *khal* and the Damoodah the villages suffered. Between the Damoodah and the line of railway, a country traversed by the Grand Trunk Road (except at Khanoo and Gulshi), there was hardly any fever. North of the line of railway we find it in Bhalkee, Eral, Sur, Deignugur, and other villages in Ausgram Thana. In this year (1871) in the north, we find that it has come along the Adjye river to Bhedia, Pogram, and Kalicapore,* spreading upwards from the river into Birbhum, and downwards further into the Burdwan district. Going along the Adjye to the eastward, we find that Paltia to the north of the river was attacked. About this place was the eastern limit of the Birbhum extension. There was a corresponding extension southwards to Juggeshurdhi on the Cutwa road, but none to Cutwa. Between the old fever tract of Purbustholi Thana and Cutwa, there was an extension upwards to Dainhat and villages about this place, but it became milder and ceased altogether as the road approached Cutwa. To the south between Cutwa and Bandmoora, there was no fever of any kind, but below this we find Bandmoora, Koroe, and adjacent villages suffering from the disease. Taking the road from Burdwan to Cutwa we find that Kurjuna, a large village through which every one going to Cutwa and Moorshedabad must pass, and only eight miles from Burdwan, was now attacked for the first time. A contagious fever travelling from Burdwan would have attacked it before those lying further inland, or beyond it to the north. Now also for the first time, Kurmon on the Purbustholi road, and Gobindpore, on the Culna road, with their adjoining villages, were attacked. The same remark exactly applies to these two places. All these are large and populous villages. Towards the end of the rains we have the fever raging over the most part of the south, east, and north of the district, and chiefly along the rivers and *khals*. To the west, between the line of railway and the Damoodah, where a contagious fever ought to be at this time destructive, except in Khanoo, close to the line, there was hardly any fever, and where it did appear the type was mild.

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* Until I visited Kalicapore in 1874, I, with others, always thought that the fever appeared for the first time in this place in 1873. This was a mistake. The fever appeared in Kalicapore in 1871, but it was in 1873 only that the villagers clamoured for a dispensary.

1872.—In the rains in this year in the north-east of the district we find a further extension upwards towards Cutwa from Dainhat to Beerah and adjoining villages, but there was none in the town or suburbs of Cutwa. To the north of the Adjye there was an extension to some villages in the Ketoogram Thana and to those along the bank of the Bhaugiruttee river for about eight miles from Cutwa. At Kandra on the Soorie road there was also a mild outbreak, but there was no fever of any kind along the road from this place to Cutwa. It has hitherto been believed that this tract of country has never had fever in it; but last year while travelling from village to village, I ascertained that the villages towards the two rivers suffered from a severe type of malarious fever such as appeared in Cutwa in 1868 and 1869, but that there had been hardly any mortality. In the north and centre of this tract, and in the adjoining villages in the Moorshedabad district, there has never been any fever. The communication line between Birbhum, Cutwa, and on to Nuddea and Jessore passes through this tract. Even in the rains I saw a good deal of communication going on, and I met an Assistant Magistrate's (of Jessore, sub-division Jenidah, I believe), horses, servants, and baggage, marching along it from Birbhum to Jessore. Clearly a contagious fever ought to have gone along this line. North of the line of railway in the west of the district, there was no further extension this year. Westward of Burdwan town, between the line of railway and Damoodah, we find that some villages as Howrah near Boodbood, Louah, Bhooree and Golegram—the latter on the Grand Trunk Road—were attacked for the first time. In this tract the disease was milder and not nearly so fatal as in other parts of the Burdwan district. In some of those which were attacked, it is doubtful whether they ever had the *jwor-bekar,* while other villages near them have never as yet had any fever. Along the banks of the river the villages as Tassoolee, Gohogram, Shongshur, Putuspore, &c., suffered most severely. The disease had not as yet attacked Boodbood station or Mancoor. If a contagious fever raging in Burdwan (only from ten to twenty miles off) in 1869 had not decimated this Grand Trunk tract in 1871, it most certainly would have done so in 1872. Going further south we find no extension westward from Indas Thana, along the Dalkissur to the north, or along the Jehanabad and Bancoorah road. South of this road, it appeared in a mild form in villages in Thanas Goghat and Kotulpore. A glance at Dr. Jackson's map will show that the Burdwan and Midnapore road crosses the Jehanabad and Bancoorah road about this place. Had the fever in Jehanabad in 1869 or 1870 been contagious, it would have followed these roads and have attacked long before 1872 these villages in Thanas Goghat and Kotulpore, and would not have left them alone, until long after it had gone up and down the Dalkissur river. Westward from Jehanabad there was a mild extension to Buddungunge and Hajeepore. This appeared to be a lateral extension from the Dalkissur river, and not from the roads. Except in Thanas Muntessur and Ketoogram; on the high and laterite soil in the west; and in the first fever-stricken places in the Culna, Purbustholi, and Gangooria Thanas, which were improving, the fever in 1872 was very severe and fatal all over the district. It was the worst year that Burdwan saw, either before or since. The remote villages in Thanas Burdwan, Mungulcote, Sahibgunge, Ausgram, Royna, and Jehanabad suffered most severely. A contagious fever in this year would have shot out undoubted and unmistakeable arms or lines along the Grand Trunk Road and main lines of intercommunication; but such a thing did not occur.

1873.—In this year, north of the line of railway and to the west of the district, there was no further extension. Mancoor on the line of railway, only 23 miles from Burdwan, and which up to this time had been remarkably healthy, suffered from a rather severe outbreak of ordinary malarious fever, but there was no mortality. Along the road from Shunamukhi to Paneeghur and Kalicapore in the north, there was no fever; neither was there any along the Shunamukhi and Burdwan road as far as Khundghose. North of this road towards the Damoodah, and in a few villages to the south—as Patrosaer, &c., there was, as in Mancoor, an outbreak of malarious fever, but there was very little mortality. Further south we can trace no extension or any fever along the Kotulpore road or Dalkissur river to Bancoorah. Some miles south of the road there was a very severe outbreak, for the first time, in Mainapore and adjacent villages on the laterite soil. In this place the villagers said that the disease had been imported from Jehanabad; but the other villages along the trade route, having more open communication with Jehanabad, never suffered from fever. In 1874 there was no fever at all in Mainapore and the adjoining villages. In October in this year (1873), there was another outbreak in Buddungunge, where it had appeared in 1872, and in the villages about Kushba in Kotulpore Thana. As I said before, this was evidently a lateral extension on to the laterite from the Dalkissur river, and such as occurred at Chunderkona in the Midnapore district. The southerly or south-east prevailing wind might account for it. In other places in 1873, there was a retrocession instead of an exaggeration or extension, and the type of the fever was milder than in previous years.

1874.—Except a mild outbreak of malarious fever at Kaksa on the line of railway, and in the villages between this and Mancoor, and also in Boodbood station, there was no extension of the disease in 1874. The western tracts as Buddungunge and Kushba suffered severely, but there was not much mortality from acute fever, or fever *per se.* To the north of this tract, where there was a severe outbreak in 1873, there was no fever. All over the district the fatal type of fever of previous years was rarely met with; the fever area declined; formerly stricken villages recovered; the condition of the more recently attacked villages improved, and the type became more unmistakeably that of ordinary malarious fever, as ague and mild remittent. I said before that the fact of Cutwa never having suffered from the "Burdwan Fever" is one of the most convincing arguments we can bring against the contagion theory. Let us now see,

Whether Cutwa was ever attacked? Cutwa is situated in the north-east of the district, at the junction of the Bhaugiruttee and Adjye rivers. It is a very large, populous place, and the seat of an enormous river traffic. It is connected with Burdwan by a very good road, and the communication between Birbhum and Jessore passes through it. It is about 20 miles only, north of the country where the fever first broke out in Burdwan. Until last rains when I visited the place on famine relief duty, and inspected the villages all round, I had been under the impression that Cutwa had suffered like other places in Burdwan. I found however that such was not the case, and that Cutwa itself and the villages adjoining it have never as yet been attacked by the fatal type of "Burdwan Fever." The fever which appeared in October 1868 (as the Assistant

Surgeon then described it) was "simply of malarious origin, "and such as generally breaks out after the cessation of the "rains and commencement of the cold weather." On 7th November in that year "there was no fever in Cutwa." In 1869 the fever was more virulent than that in previous year, but there was hardly any mortality. In 1870 there was no fever in Cutwa, neither has there been any since 1869. In 1870 it was raging in Dainhat about six or eight miles down the river. I ascertained that in the suburbs of Cutwa they never had any fever. Going south-east to Mundulhat I found that they had no fever in that place, but in the next village of Beerah they had it in 1872, and from this down along the river all the villages suffered. To the east of Cutwa the nearest (six miles) affected village was Shambazar. Five miles from Cutwa along the Burdwan road, we find that the large and populous village of Sreekund has never suffered from fever. South of Cutwa to Soodpore there was no fever, and in 1871—the only unhealthy year they had—only three persons died of fever in that village. Further south of this, we get into the fever tract which passes downwards and eastwards towards the big river. In Cutwa there has been always a good hospital under an Assistant Surgeon. During the past three years, while the temporary dispensaries in the fever tracts were daily attended by hundreds, the daily average sick at the Cutwa dispensary was only 30 or 40. During the famine we daily fed hundreds of paupers at Cutwa, and on going down the line, from the appearance of the people and children, we could distinguish those who came from Cutwa and its vicinity, from those who came from a distance or fever-stricken places. Cases of spleen or of the sequelæ of the fever are rare in and about Cutwa. It is clear then that Cutwa and its adjacent villages never suffered from "Burdwan Fever." Why it did not do so, I shall endeavour to explain hereafter. Except a few of the villages along the Bhaugiruttee, and those nearer to the Adjye in the

Ketoogram Thana, there was no fever in the country north-west of Cutwa. In the high laterite soil to the west of Ausgram, there was also no fever. In the central part of the district about Thana Muntessur, there was good deal of ague and mild remittents, but no fatal fever. In the tract to the west of Burdwan, some villages, as Khanoo, suffered severely, but in many others there was only ordinary malarious fever. In the villages between Boodbood and Shunamukhi there has been no fever. Along the Shunamukhi road to Bancoorah; along the Dalkissur from Bamooneah; and along the Jehanabad road to Bancoorah from the Kotulpore Thana, there has been no fever.

Upon a consideration of the whole history and progress of this fever, I think we must come to the conclusions.

1*st.*—That it was not contagious.

2*nd.*—That it did not extend along roads or traffic lines.

3*rd.*—That it chiefly extended and was worst along rivers, *khals*, and *nullahs*.

The next important question is—

What was, or is the nature of the fever? In my former paper in the XXXIInd number of the *Annals*, I gave it as my opinion that the disease was and is a purely malarious fever, and that the fatal type (*jwor-bekar*) was a malignant remittent. I gave some clinical cases of this form of the fever. Dr. Jackson says it was *typho-malarial*, Dr. A. Verchere said it was *typhus*, Dr. J. Greene that it was *typhoid*, and all other observers, as Dr. D. B. Smith, Dr. Payne, Dr. Elliott, Dr. Mantell, and all the Inspecting Medical Officers—as Dr. Robinson, Dr. Roy, Dr Dutt, Dr. B. B. Gupta, Dr. F. C. Ghose, and Dr. K. P. Gupta that it was (what we have always recognised by the name of) *malarial or paludal fever*. In a former paper in the *Indian Medical Gazette*,* I endeavoured to show that it was not enteric fever. The differences between the two fevers are distinct; and as nearly every observer has agreed that it is not enteric, we may leave this disease out of the question. Dr. Jackson owing to his other duties, and Dr. Verchere from want of time, did not, in fact could not take up cases of this fever and watch them from day to day. Hence from too few observations, they were misled as to the nature of the disease. Alison wrote:—"If any one had seen only the milder forms of "*remittent fever*, and had no opportunity of tracing up its "several grades, he might well believe when he saw the severest "variety that he had before him a distinct affection" (Aitkin, Vol. I, page 504). This is exactly what has occurred in the case of the "Burdwan Fever." I shall now give Dr. Jackson's description of the fever and its sequelæ. In para. 365, page 74, he thus writes:—"In every locality visited by "me I found existing—(1) a multitude of chronic cases, of "which the type was almost always intermittent, very rarely "remittent. In very recent cases the intermission was "quotidian; in the older cases quartan or quintan—(2) a "small number of acute cases of continued fever, with no well-"remarked remission whatever—no greater amount of remis-"sion, in fact, than accompanies all cases of acknowledged "continued fever. In these cases there was no premonitory "ague or cold stage; after two or three days of lassitude, loss "of appetite and malaise, the fever appeared, the skin be-"coming hot, the head heavy, the tongue coated with grey "fur, the urine scanty, and the bowels confined. Some-"times nausea was present, but oftener not. There was "always distaste for food, perverted taste, and thirst. From "the very first the patient had a stupid, drowsy, brain-"poisoned aspect—was unwilling to answer questions; the "intellect gradually became more and more confused, and "he lost the power of understanding what was said to him, "and it was only by shouting that he could be roused at all.

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* I think it was No. 4 of Vol. IX.

"From the first also there was intense prostration and loss of "muscular power. In the cases that proved fatal, the stupor "passed rapidly into coma, and after 12 or 36 hours "of utter insensibility, death occurred. Some of these cases "proved fatal in 3 days; others lasted a week or 10 days. "In the more protracted cases which proved fatal, there was lung "engorgement and pneumonia, the urine and fæces were often "passed involuntarily. The most striking symptom was the "early stupor, and the rapidity with which coma supervened. "In such cases the conjunctiva often remained perfectly clear "and uninjected to the last. Hepatic or splenic tenderness or "enlargement was rare. Acute delirium was not very common, "but I was told by villagers of cases in which all those which "proved fatal were accompanied by delirium, the patients "endeavoring to run out of the house to drown themselves. "These acute cases are numerous enough; they constitute *the* "fever: but my visits to the infected tracts were made in "December, January, February, March, and April, when "matters have begun to mend; and though such cases are met "with up to March, they are comparatively few in number after "December."

It must not be supposed that all these cases of so-called continued fever commence in this abrupt manner. Many suffer at first for a few days from ordinary ague, which passes in one or more days into mild remittent, and then into the state so well described by Dr. Jackson. From my own experience I should say that delirium is present in the majority of cases, and it is sometimes so violent as to require two or more assistants to keep the patient in bed.

"In the cases which recovered from the first seizure, there "was, after the 7th to 10th day, a period of improvement "during which the patient seemed quite well, but weak. The "skin became cool, the tongue moist and clean, the appetite "returned, the intellect was once more clear, and only a sense "of prostration remained; but invariably, so far as I could "learn, at a period described to me at from 5 to 8 or 9 "days afterwards, there occurred a relapse, the symptoms of "which exactly resembled those of the original seizure. The "relapse was generally milder, and a greater proportion of "patients recovered from it than from the original seizure. The "duration of the relapse was 5 or 7 days. On recovery "from the relapse, at a varying interval in different cases, "generally more than a week, the patient was attacked with "intermittent fever, quotidian at first, and subsequently becom-"ing tertian or quartan. The cases then come under the head "of chronic cases, the liver or spleen enlarges, the skin "becomes sallow or pale, and the sufferer, who is now able to "attend the local dispensary, is *either cured by quinine*" (the italics are mine) "or lapses into a dropsical condition, or is "attacked by dysentery or diarrhœa, and dies. It is from these "chronic cases, the sequelæ of the ague, which alone are seen at "the dispensaries that the essentially malarious character of "the disease has been assumed, and it is from the aspect which "these poor creatures present that the inhabitants of the district "generally have been incorrectly described as resembling the "dwellers in the fens of Lincolnshire."

Now I am sorry to say that all this is very misleading and suggestive of *relapsing fever*. It shows us how cautious we ought to be in putting leading questions to natives, and then accepting their answers as facts. The real facts of the case are, that in many cases a man suffering from this form of the fever, if uncomplicated, gets better or well after an uncertain number of days; or, in other words, he gets an intermission, which may also last for an uncertain number of hours or even days. Now comes on the remittent again, but in a milder form, which also lasts an uncertain number of days, and passes off. Now again, this remittent is succeeded by ordinary ague attacks. In other cases the first attack may be a mild remittent, which terminates in an intermission, and then he gets the malignant remittent and dies in it. There is no certainty as to the duration of the remittent, the remission or the intermission, or even of the convalescence; neither is there any regularity in the occurrence or *recurrence* of these attacks. Uncomplicated and non-treated cases generally follow this course; but when cases are properly treated with quinine, there is hardly ever a relapse of any kind, or if there be, it does not take place until weeks or months after the first attack. It is wrong to call these *relapses:* they are *recurrences* of the remittent or ague, and no two cases are alike as to regularity or irregularity, course or duration. I do not agree with Dr. Jackson that it is from "these chronic cases" that "the malarious character of the disease has been assumed." These very typhus-looking cases, by the thermometer and constant watching, by their general symptoms, by their course, progress, and termination, have been diagnosed as malarious fevers. These cases, in the fever-stricken village, are comparatively few, while hundreds are down with ordinary ague of various types and severity. I shall have more to say hereafter of the Lincolnshire fens.

Dr. Jackson further writes:—"As regards *the* fever—the "acute cases, which the natives call *jwor-bekar* and *nootun-"jwor*—it reminded me very much of typhus. I sometimes "looked for, but never succeeded in finding, an eruption. I "never saw any case which led me to connect it with enteric "fever. One very noticeable circumstance about the disease "was the horrible sickening odour exhaled by the sick.

"Quinine, which was very efficient in chronic intermittent "cases, had no effect on the acute cases, and failed entirely in "my hand to prevent a relapse. I had no opportunity of "making any careful clinical study of the disease. I never "saw any one case from the beginning to the end. I have "seen the same case half a dozen times during the course of "the original attack, period of freedom, and relapse. I have “seen cases during every stage of the disease, and been present “at very many deaths. The first indication of the presence “of the fever in a village is the occurrence of a few cases “of this *jwor-bekar*, of which comparatively little is thought “at the time; in the ensuing year, however, more of these “cases occur earlier in the season than the ordinary malarious “fever, and multiply with great rapidity as the year advances. “I have noticed that where deaths from this cause occur during “the year of invasion, there are deaths in *the same houses* during the following year in more than half the number of cases “noted.” The terms *jwor-bekar* and *nootun-jwor** really mean nothing. Every kind of *unusual* fever is *jwor-bekar*, just as they call an unusual case of small-pox—*Búshantho-bekar*. *Nootun-jwor* means *new* fever, or the commencement of that which occurs every year. The sickening odour I do not think is peculiar to the fever. We do not find it in the hospital in these cases, and we perceive it in other diseases when treating natives in their own huts. It arises from the exhalations from the body mixing with the smell of the oil which has been rubbed on the skin, in a small, confined ill-ventilated apartment. I think all these cases, if uncomplicated, are curable by quinine, but it must be given properly and at suitable times. I was most successful in my treatment of these cases, and at present I follow it in my hospital ward. While the skin is very hot and dry—in fact, when the man lies in the state which Dr. Jackson has described—I never give quinine, but I give the carbonate of ammonia and spiritus etheris with cinchona, every 3 or 4 hours; 5 to 8 grains of the former, and 25 to 30 minims of the latter.† I continue this treatment until, by the thermometer, I get a remission, and then I give 5 to 10 grains of quinine every hour, or every second hour. In the exacerbation I again go back to the ammonia and ether, and in the next remission to the quinine until the fever disappears altogether. For days we may not be able to give a single dose of quinine, but after a longer or shorter duration, in cases without symptoms of congestion of the brain, we are sure to get the opportunity. I hardly ever lost a case of these uncomplicated typhus-looking fever cases, and I never saw the relapse that Dr. Jackson speaks of. After an uncertain time they are very likely to be again prostrated with a milder remittent or frequent attacks of ague and spleen. I am convinced that in these cases, those medicines—ammonia and ether—which considerably reduce temperature, are not employed as often as they should be. *I say then, that if quinine be given at proper times in these malignant remittents, it will cure the fever and ward off the recurrences and subsequent ague attacks.* With the latter part of the quotation I do not agree. In nearly all the attacked villages the advent of the fever appeared by an exaggeration of the number of ordinary ague cases and mild remittents. In the second year there were a greater number of ague cases, and also a greater proportion of malignant remittents. As the rains continued, these remittents multiplied. In every village in each year the disease commenced by ague cases, and afterwards the malignant remittent supervened. At the end of the year they disappeared in the same way, first by a decrease in the number of malignant remittents, and afterwards by a diminution in the ague attacks. Intensity or severity is the only difference between an ague and a fatal remittent. An ague case, according to this view, may be compared to the coryza which foretells chronic arsenical poisoning, and the fatal remittent to a case of acute poisoning by that drug.

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* The meaning of the word “nootun” is *new*, and “nootun-jwor” means *new fever*, or first attack of fever.

† Dr. R. Bird of Howrah has shown that these drugs are most efficient in reducing the temperature of the body.

In para. 240, page 46, Dr. Jackson writes:—"There were "two places where I could see cases, *viz.*, at the dispensaries "and in the villages themselves. At all the dispensaries were "to be seen daily, between 7 A.M. and noon, a crowd of from "100 to 300 people, among whom women and children predominated, and who had come for relief from villages within "a 2 or 3 miles radius. All these were 'chronic' cases "(as they were called) of fever which was of intermittent "type, or cases of anæmia, jaundice, splenitis, anasarca, dropsy, "diarrhœa, enlarged parotid or cervical glands, and among "young children occasionally cancrum oris,—all resulting from "repeated attacks of a fever, which, whatever it may have been "at first, had eventually an intermittent type. Some of these "people were attenuated to the merest skin and bone; others "with emaciated limbs and pinched, worn features, had œdematous hands and feet and swollen bellies; most of them "were very weakly. A considerable proportion were jaundiced, "and had enlargement of the liver, and the majority, the children especially, had enlarged spleens."

We know such affections to be the sequelæ of a paludal fever, and of no other.

In para. 242 we read as follows:—"In the villages one saw "worse cases than at the dispensaries—the poor dying creatures who could not possibly attend them—and here though "most of the cases were 'chronic' intermittent fever and its "sequelæ, there were others of somewhat different character. "In many of the villages, although at the period of my visit "new cases were comparatively rare, I occasionally saw a dying "person, the history of whose case would be something like "the following:—A son would tell me that his father had been "out of sorts and oppressed for two or three days, and that "while they were out in the fields together, he had suddenly "declared that he was unable to work any more, and returned "home. He had no fever, no attack of shivering succeeded "it, but he became hot, ached all over, was sullen, could "not eat, did not like people to talk to him; only spoke to "ask for water, and was heavy and apathetic. He was “never very hot, but the fever never went away; some- “times he would groan, but was generally quiet. The bowels “were confined. He still would not eat, and became angry “when pressed, or if spoken to; then he seemed stupid, and he “could not understand what was said to him. Sometimes he had “to be called many times before he could be roused; then “he became insensible but could breathe? Well! afterwards “he became like this. He had been ill 3 or 4 days, some- “times a week. There was no enlargement of the liver or “spleen. I could find no eruption, the man was comatose, “had hypostatic pneumonia, and was dying.”

“I never saw a single case all through. I came across cases of “this kind in various stages; in none of them did I see jaundice, “or hepatic or splenic disease. I never saw any eruption, nor the “ferrety eye of typhus; still something about these cases brought “typhus very broadly to my memory, and sent my mind wan- “dering back to 20 years ago, when I saw much typhus “fever among the crowded alleys of a large manufacturing “town.” * * * We cannot wonder at these unusual symptoms in these cases, when we find even more extraordinary ones in ordinary ague. In para. 244, Dr. Jackson writes:—“I saw “cases of recovery from the disease, but almost always (in “fact always, I cannot call to mind an instance of the con- “trary) there was a relapse 5 or 6 or 7 days after recovery “from the first attack, and after the second attack had passed “away pronounced intermittent fever appeared with the usual “succession of cold, hot and sweating stages, and now the spleen “(chiefly in young people and children) began to be affected. “Some of these cases of intermittent fever were somewhat “remarkable. A man would present himself as suffering then “and there with fever. He was not perceptibly hot, or very “slightly so; the pulse small and quickened, but not very much. “The people round would say, ‘yes; he has fever, don’t you see, “sahib, he has it now;’ but I could not see it for a time, the only "sign of variation from ordinary health being a glassy, stupid "or drowsy eye, and a slightly drunken aspect. Some three or "four hours afterwards, when the fever had gone, I could detect "the change in turn; the drunken appearance giving place to "one of fatigue only, and these were the only symptoms detectable. Such attacks like nearly all the prevalent ague, would "come on every third or fourth day. Quartan or quintan "types were by far the most common. Another peculiarity "was the uncertainty of the period of attack. In the same "individual the accession would be sometimes in the morning, "at others at night, or noon, or in the night; people going to "bed well, and waking up at some variable hour with fever "on them."

Writing on the fever in the northern part of the district, Dr. Jackson, in para. 266, page 51, says:—"In every place "I visited I learnt that the first year of the fever was the mildest; it was generally most intense the third year; but in "the very old, effete, decaying villages, such as Mungulcote, "Amdhobe, Galishta, it was very intense and fatal during the "*second* year." In the next para. he writes:—"The character "of the fever, judging from 99-100ths of the cases seen, would "by any unbiased observer have been set down as malarious. "The sequelæ were just those due to a prolonged exposure to "malaria, and by far the majority of the children in the badly "stricken villages had enlarged spleen. Cases of anæmia, "dropsy, anasarca, jaundice, enlarged liver, enlarged spleen, "diarrhœa, &c., abounded, but all of these were chronic cases. "There was very little new fever at the time of my visit."

It is a most significant—and to my mind diagnostic—fact that in every fever-stricken village an enormous number of spleen cases are to be seen. Without asking a single question, but from mere inspection of the children we can tell whether or not the village has ever been attacked by the fever. While going about in the district last year, in 70 villages I collected all the children together and made out a ratio per cent. of spleen cases to total strength of children in each village. This I did in the fever and non-fever tracts, and the numbers varied from 0·48 (Boodbood) and 0·63 (Shunarundhi, Ketoogram Thana) to 72·18 (Chote Kund) 67·25 (Khano) and 58·10 (Tassoolee). A few instances from Dr. Jackson's report will show the prevalence of spleen.

Jowgram-Selimabad Thana.—" In this village I examined all the people we saw, and every individual—man, woman, child, or baby—had hypertrophied spleen. One baby 6 months old had an enormous spleen, and the mother who was similarly affected, affirmed positively that the child was born with it."

Kurjuna—" On examining the children I found that one in four had enlarged spleen."

Meerpara—Here he saw:—" 60 per cent. of the children suffering from spleen."

In Aureh—" 40 per cent. of the children had spleen."

Mungulcote—" At the time of my visit the fever had greatly " abated, only relapses and chronic cases were to be seen; but " from the great amount of spleen, anæmia, and debility " seen on every side, there could be no doubt that there " would be a great mortality in 1872." I might multiply these instances, but those I have given are sufficient to show the state in which this fever leaves a village. See also the statement showing admissions from fever, spleen, &c., for 1874.

I shall now give an extract from a paper published by Surgeon G. C. Roy, M.D.,—a careful observer, and one who has seen a good deal of the fever—in No. 3, Vol. IX of the " Indian Medical Gazette."

" In my last paper I attempted to prove that the present " fever in Burdwan partakes of the characters of an epidemic, " though essentially the type of it is no other than what used " to be called " endemic malarial." That it is not typhus will " be ascertained from the observation of symptoms which are

" noticed in the majority of instances. The first attack always
" proves continued or remittent, and is looked upon as danger-
" ous. After the prodromata of general languor, lassitude,
" costiveness, want of appetite, &c., the fever is ushered in by
" a chill followed by the hot stage of several hours' duration.
" Generally, there is complete intermission in the first day,
" but next morning the attack recurs. The symptoms are now
" more exaggerated, face become flushed, intense thirst, tongue
" thinly furred, headache attended with bilious vomiting, and
" some times delirium. The patient feels an intense pain in the
" limbs as if bruised all over. The hot stage may or may not
" be followed by sweating, but there is no more that feeling of
" ease after the lapse of a few hours. The fever remits, and yet
" he feels thirsty, drowsy, and heavy in the head. The temper-
" ature reaches its maximum, and ranges between 102° to 104°
" with a fluctuation of 2° to 3° between the morning and evening
" indication. This state continues for three or four days, when
" prostration becomes greater, tongue more thickly coated, and
" delirium supervenes, which takes place more often at night,
" and is of a quiet nature. Bowels remain costive, and active
" purgation is very badly tolerated. On the 5th or 6th day
" copious sweating brings the case to a termination. If the
" strength be not properly supported throughout the illness,
" the diaphoresis may end in collapse. The skin gets cooled
" down to 96° or 97°, and if advantage be not taken of this
" period of quietude to quell the storm with good doses of
" quinine, we may expect in the evening a recurrence of the
" symptoms which, however, instead of continuing now become
" intermittent in character. Thus, along with the decline or
" severity of the disease, we have the different phases of inter-
" mittent, remittent or continued fevers in one and the same
" individual, the different types being well marked both during
" the period of invasion and subsidence. This merging of one
" type into another, distinctly observed at its commencement

"and end, distinguishes it from typhus, which runs its equable "course, and ends in complete and sudden defervescence. Thus "an ordinary case takes seven or eight days before convales-"cence is establised; but when once under the influence of "fever, the slightest cause as exposure, fatigue or irregularity "of diet will bring on what is ordinarily called a "relapse." "This relapse, unlike relapsing fever, does not observe any "regularity as to time. In some it is quotidian, tertian, quartan, "weekly, fortnightly or monthly, according to the capacity of "the individual to withstand its effect. . . . . . . My "experience confirms me in the belief that the epidemic is not "contagious."

Although this excellent description of the symptoms is true of the majority of cases, yet we do meet with some, much more sudden in their advent, partaking more of the continued fever type, with more violent delirium, and much more like typhus than the cases which Dr. Roy thus so ably brings to our notice. (See the cases detailed by me in the XXXII No. of the *Indian Annals.*)

From the foregoing I think we can very plainly see that the fever was a malarious or paludal one, but then Dr. Jackson says that it was *typho-malarial,* which must mean a new disease formed by the combination of the two poisons. In the case of the Burdwan Fever it cannot mean typhus attacking malarious-stricken subjects, for in every instance the malaria came with the typhus and was always found associated with it. From seeing some cases present a typhus aspect, and from the fever being — as he believes — contagious Dr. Jackson formed this opinion. He says:—"the cases rather suggested typhus, but I could never decide to the satisfaction of my own reason that it was actually typhus."—That it was not contagious I have endeavoured to show. In my former paper in the *Annals* will be found some clinical cases of this typhus-looking fever. Other observers have seen similar cases in Assam, Burmah, Mauritius, in Walcherin and other places. What does Dr. Murchison say? "The remittent fevers of this climate can "never be mistaken for typhus; but certain forms of "tropical remittent fever, known as "typhoid or malignant remit- "tents, and "Jungle fever," occasionally present symptoms hav- "ing a close resemblance to those of typhus, such as a small soft "pulse; dry, brown, retracted tongue; dorsal decubitus, and "great prostration; low muttering delirium; tremors, and "subsultus; contracted pupils and even petechiœ. Some years "ago, I had an opportunity of seeing many such cases in "Burmah," Treatise on the Continued Fevers of Great Britain —Second Edition.

I can understand—but I have never seen it—typhus breaking out in a malarious-stricken village, but I cannot understand typhus and malaria poisons combining, and forming a third disease. As well might we expect small-pox and measles, or small-pox and scarlet fever to combine (instances have been met with in which these diseases were present at the same time in the same individual) and produce a "*varioloid-morbilli*, or a *varioloid-scarlatina.* But supposing malaria and typhus did combine and produce the "Burdwan Fever"—

(*a.*) Would they stick close together, pursue the same course, and follow exactly the same laws?

(*b.*) In a village would they commence together in the rains, and die out together at the end of the rains by an exaggerated number of ague cases, mixed up with a greater or less proportion of ordinary and unmistakable remittents?

(*c.*) Would they appear mild in first or second year and severe and fatal in second or third?

(*d.*) Would they pass over roads, leave traffic routes and many over-crowded villages, and follow chiefly river banks and small streams?

(*e.*) Would the typhus only disappear in 1874, and leave the malarious fever to take care of itself and rage wherever it liked?

(*f.*) Would the disease, years ago, have avoided the crowded towns along the roads and river to Calcutta, or in later years have obstinately refused to go up the Grand Trunk Road from Burdwan town, or from within a few miles of it?

Typhus would be likely to rage in the hot weather; to part company after a short time from the malarious fever, and to be clearly, separately and distinctly traced along its own path. It would run along main roads, lines of traffic or intercommunication, and would first attack the most filthy and crowded villages. Its advent would not be announced, its stay supported, and its decline followed by agues and ordinary remittents in an unusual and excessive number. The convalescence after typhus would be slow, gradual and progressive, and the patient would not be subject to *recurrences* of malarious remittent and ague. Typhus would not be followed by the sequelæ of paludal fevers. Cases of contagion would have been beyond all doubt, and the attendants upon the sick would have been first attacked.

If we now carefully consider all the evidence for and against; the history from previous years; the progress of the disease; the mode of invasion and termination; the general symptoms; the period of convalescence; the sequelæ of the fever, and state in which it leaves a village; the maxims handed down to us by authorities, and the observations of other investigators, we must, I think, come to the conclusion—*That it is a purely malarious, non-contagious fever, without any typhus element in it, and that it differs only in degree or virulence from the ordinary autumnal malarious fever of Bengal.*

Having now disposed of the nature of the fever, I come to the next most important subject in connection with it, *viz.* :—The Drainage in Burdwan.

In para. 314, Dr. Jackson thus sums up:—"On the whole "I am of opinion, from careful examination, that the district "of Burdwan is not badly drained; that on the contrary, it is "better drained than many of its neighbours where no such "prevalence of fever obtains; and that the origin of this "terrible fever is quite independent of, and unassociated with, faulty drainage."

Had Dr. Jackson inspected the district during the rainy season and up to October or November, I do not think he would have formed the opinion to which he gives expression in the above paragraph.

In para. 100 he writes :—" Selimabad on the opposite bank," (of Damoodah) "a little southward, is situated close to the "mouth of the Kana Nuddee now closed by a bund. It has "a bund between it and the Damoodah, and a second bund "behind it, and seems consequently to be deprived of all "drainage whatever. The water on the banks is very foul and "shallow. The interval between the Damoodah and the Kana "Nuddee bund is sandy and several acres in extent, which is "covered annually by the Damoodah, the water being only "kept out of the village by the bund. The percolation "beneath the bund must keep the soil of Selimabad damp. "There was a great amount of chronic sickness, especially of "anœmia, debility, malarious cachexia, spleen, &c. The police "were all ill, and nearly all the men and women had spleen. "It appeared to me that the fever I saw was simply due to "local causes, especially impeded drainage, and could only be "obviated by sluicing the bund and adopting suitable measures, "for efficiently draining the site of the village" There are other instances in Dr. Jackson's report of badly drained places having been found by him in the *dry weather*.

After travelling all over the Burdwan district in the rains and autumn, I formed the opinion that it is one of the worst drained—if not the worst—in Bengal, and that in those parts of it which are well, or better drained, the fever has not appeared at all, or only in a mild form. Now, by drainage, I do not mean that of the surface water which we see in every village and place during the rains and lying on the *dhan khets*.* By drainage I mean

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* Rice-fields.

sub-soil water drainage. The rivers Adjye, Bhaugiruttee, Damoodah, and Dalkissur in the rains, by the height to which they rise, obstruct the drainage inland and all throughout the district. Not only are they no longer able to receive the water from the *khals* and *nullahs,* but they even flood them, reverse the currents, and inundate the country. If in the rains or autumn we visit Purbustholi on the Bhaugirutte; villages in Culna Thana near the river; Ekloky and Jehanabad on the Dalkissur; the suburbs of Burdwan on the Banka; Mungulcote, Kurjunah, Bhedia, Shongshur, and many other places which have suffered most severely, we find them as wet and damp as it is possible for them to be, and no places are so subject to seasonal and sudden changes in the sub-soil water drainage as are those villages along the banks of the big rivers and *khals.* See them in the dry season, and the reverse is the case. In these villages the surface drainage is generally away from the river and not into it; but it is when the river gets swollen, and its level high, that they chiefly suffer. Then the pressure of the water acts on the sub-soil, and forces the water in it up to the surface, and these influences are felt at some distance or rather a considerable distance inland. The *khals* bringing down the country water are now in their turn obstructed or have their currents reversed, producing exactly a similar state of affairs in the villages along their banks and further inland. The villages continue in this state for a longer or a shorter time, and then down goes the river; there is a rapid fall, followed by as rapid a sinking of the sub-soil water which runs into the river; sudden and progressive drying of the surface, and great evaporation. Fever then breaks out. This falling in the river not only thus affects the villages on its banks, but also those inland close to the *khals,* which now rapidly flow into the river, and drain the country on both banks and for a certain distance in from them. Villages that are subject to this extreme dampness and sudden draining, with quick evaporation from the soil, have suffered most intensely from the fever, and it is owing to this cause that it extends along the streams. No fen or *jheel* is necessary for the production of the malaria. What we want is a porous sub-soil saturated to the surface with water; rapid drainage causing this quickly to recede, and a hot sun overhead to dry the recently damp ground. One day's or night's production of malaria may suffice to poison people for a long period, and over a considerable area or at a considerable distance from the malaria-producing place. Winds will waft it hither and thither, and under-wood, and jungle, &c., will suffice to retain it. These changes and conditions occur upon several occasions in the same village, from the time the river first rises, until it falls for the year after the termination of the rainy season. While the rivers are full the fever cases increase, and the maximum is attained just after this final fall takes place. From this onward until the next rainy season, the fever cases decrease, and the disease abates. We saw that in Burdwan the fever season generally commences in July or August, and gradually increases until the middle of November or first week in December, and from that time decreases until the succeeding rains. The rivers fall long before the maximum is attained, but we should expect that intense malaria evolved in (say) end of October would produce fever in the inhabitants of the place during the whole of November.

Similar results, under similar conditions, have been observed in clearing low forest grounds for cultivation purposes. In such places we have a wet porous sub-and surface-soil, covered with dense vegetation, and remaining permanently damp from the fact that no sun or heat can penetrate through the dense foliage. Let the trees be now cut down, the under-wood cleared away, the soil exposed to the sun's rays, and the place is rendered at once and for a considerable time extremely unhealthy. In this case the sun only rapidly dries the soil which had been wet and damp for years; but in the case of water-logged Bengal villages, not only have we the sun, but also we have at the same time a neighbouring river or *khal* producing a like result. If we examine a tract of country where there are swift and unobstructed *khals* which fall into the main river at such an angle, and in such a way, from physical or other conditions, that no impediment to the continuous and onward flow is offered; where there is regular, constant drainage from the country and villages, and in consequence no pent up, or rapid recession of sub-soil water, we find little or no fever. Such tracts we meet with in the central part of the Burdwan district in Thana Muntessur, and in Ketoogram Thana beyond the Adjye to the north-west of Cutwa. In para. 368 of his report, Dr. Jackson thus writes:—"Two areas have escaped the disease, of which the distinguishing features are as follows:—One is low, moist, fertile, "contains the average district population per square mile, is "purely agricultural, belongs to the district of Moorshebad, and has no road connecting it with the fever tracts "of Burdwan or Birbhum, and no traffic with those districts. "The other is somewhat higher and drier than the average, is "unfertile and sparsely populated (492 per square mile), as "compared with the average of the district, which is 578 per "square mile, and has no road crossing it save a mere tract. "North and south of this area, where there are roads and "traffic, there has been fever also. West of the former area "along the road line, there is fever also; *in the areas themselves* "*which resemble each other closely in no particular save their* "*isolation from infected portions of Burdwan, there has been no* "*fever whatever.* The exemption of these areas, under the "conditions mentioned, is corroborative of the conclusion that "the disease spreads by importation and communication from "and between attacked and healthy villages." If the facts are correct, the conclusion is correct, but since they are wrong, the latter is erroneous. The first area is the one I allude to as being to the north of the Adjye, and extending into Moorshedabad. I showed before that this tract had fever in its borders near the Bhaugiruttee and Adjye rivers, and that the centre never suffered from the disease. I also pointed out that this centre is traversed by a road of considerable importance—ridable in the rains—from Nuddea, Jessore, Cutwa, and through the fever-stricken tract in the Birbhum district on to Soorie. There is considerable trade with Cutwa, and the road joins that from Burdwan to Moorshedabad.

The second area is that to which I allude as being in the Montessur Thana. The road from Burdwan to Purbustholi — along which my messengers travelled in the height of the rains — runs through this tract, and is even more open during the rainy or fever season than many of the main roads in the district. North and south of this area where we find the fever, we come upon the obstructed *khals*, and not upon traffic lines. Traffic in the rains is carried on chiefly by boat. Now, the real common difference between them and the fever stricken-tracts is in the rapid, steady, and progressive drainage which takes place from all the villages and goes on from the whole country. I never saw so many good, swift, and deep-running *khals* in any other place. In the dry weather we can form no idea of the really good drainage which goes on in the rains from these places. A sluggish stream, or a reversed current, is nowhere to be seen until we get into the fever villages.

Now, let us see the state of a river through the fever-stricken country. We will take the Koonoor Nuddee, because of the severity of the fever in the north. Along or near this river, the villages were decimated. This stream passes through the Ausgram Thana, south of Keshera, Chanoke, by Mungulcote, and into the Adjye. After the commencement of the rains the *khal* fills, and the water runs rapidly into the Adjye. As the water in the latter rises, the Koonoor current becomes slower, and when a certain height of the water in the big river is reached, it is apparently stopped or a reverse current is established by the Adjye water flowing backwards through the *khal.* The water now spreads over the country, inundating the villages, and trying to find other outlets towards the east or south. This state of affairs lasts for a longer or shorter time until the water in the Adjye goes down, and then come the running off of the water through the *khal;* the sudden drainage; rapid subsidence of sub-soil water; drying of the surface, and great evaporation.

In some of the villages, a good many of the houses are built on mounds, and have suffered severely. As they have been beyond the reach of the drainage influences, it has been assumed that the fever was produced in them by contagion from without. Now, it is not at all necessary to assume this. The village is generally close to such a water-logged soil or malaria-producing tract as I have described, or one part of the village itself may be in this state, and the other higher, and as malaria is not stationary or confined to the spot which produces it, we must expect these houses or sites to suffer from the fever. This is true of Mungulcote, a place which in the dry season we should pronounce well-drained, but parts of which in the rains are regular malaria-producing tracts. The country on either bank of this *khal* is also in the same state during the rains, and so is that along the *Khurian-nuddee,* the *Mundassuree-khal, Kanchee-khal,* the silted-up *Sapjola-khal,* the *Banka,* and many other *khals* in the district. We can thus form two opposite opinions of the drainage of a village or tract, according as we inspect it in the wet or the dry season.

In para. 282, Dr. Jackson writes:—" One peculiarity of this " southern and density-populated area was the *great depth of* " *the water from the surface and the early date at which the* " *tanks dried up.* Thus at Purbustholi there were several " large tanks, the banks of which had been washed back, so as " to considerably diminish their depth, and all these were quite " dry in January: I rode through one of them. At Paroolia " I saw another tank fully 20 feet deep, but almost dry. At

" Ekdala I met another nearly dry tank which I plumbed, and " found to be 30 feet deep from the road level to the bottom. " It contained but a small pool of water, the surface of which " was 2 or 3 feet below the bottom of the steps of its pucca* " ghâts, and this in the month of January."

Now, this is exactly what we should expect to find in these places in the dry season. These villages are along the bank of the Bhagiruttee river, or within the influence of its drainage operations. If in the dry season we stand on the bank, we see the surface of the stream far away (30 or 50 feet) below us. As the river subsided from its maximum height, it drained the sub-soil not only on its banks but far inland, and in consequence we find the tanks and wells nearly dry, or down to the level of the stream in the neighbouring river. The further we go from the river, the longer do we find the drying up, or rather draining process delayed, and those wells or tanks near the river-bed, are drier earlier in the season than those further inland. In these very places when the river was at its height, the wells and tanks were full, the *khals* and streams were obstructed, and the sub-soil water was forced up to, or very near to the surface. As the river rose and fell, and fell and rose, the changes before described as productive of fever, occurred at different times. From a cold weather tour in 1872 and in 1873, I was also misled as to the real state of the drainage of these apparently high and dry villages on the banks of rivers and *khals*.

I said before that Cutwa never suffered from the " Burdwan Fever" or *jwor-behar*. I shall now endeavour to point out why it did not. Cutwa site is the highest and driest in the north or east of the district. As we approach Cutwa from Burdwan, we find that the level of the country gradually rises, and within two or three miles of the town, this rise is more apparent. To the south-east of the town there is a large *bheel*† into which the surface-water drains. On the north we have the Adjye, and on the east the Bhaugiruttee, and when these rivers attain their maximum height, there is still a considerable difference between the level of the ground and that of the water in the stream, so that in the height of the rains Cutwa is as well drained as it is necessary for it to be. The elevation of this site above the surrounding country, which prevents a water-logged sub-soil, in my opinion saved it from fever. In 1868 and 1869 it however suffered from an exaggerated number of ague cases and mild remittents; but malaria wafted from the west along the Adjye banks, and from the south-east may have caused this, or perhaps the excessive rains (14·50 inches) in September in 1868 and (6·90 inches) in October 1869 may have caused an evolution of malaria in Cutwa itself in these years. The country to the south and south-west of Boodbood is also high and well drained, and here also there has been no fever.

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* Solid masonry.

† Small lake.

I generally remarked that the villages in the vicinity of a large *jheel** suffered very little, if at all, from the fever. This is owing to the fact, that from the *jheel* the level of the land rises to the village site, and in consequence there is free drainage from the village into the *jheel*, and thence into the *khal* and river. These *jheels* or *bheels* can be found in the Muntessur, Cutwa, Ketoogram, and Boodbood Thanas. The drainage of Sreekund, a very large village near Cutwa, which has never suffered from fever, is into a large *bheel.* So is Soodpoor to the south of Cutwa, villages in Thana Muntessur, and in many other places. The fact of the healthiness of some of these villages in the vicinity of *bheels* has been used as an argument against the malarious nature or origin of the fever. In para. J, page 75, Dr. Jackson thus writes:—" Villages situated near " bheels in Burdwan were not more unhealthy than others: on " the contrary, such places, even when on sites which are annu-

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* Small lake.

"ally submerged, and where the water drains away very slowly, "have compared favourably as regards the fever with other "drier and better drained localities. The people of these "supposed fenny districts *need water so badly*" (the italics are mine) "that rather than drain and cultivate the jheel lands as "they exist in Burdwan, I should like to see them deepened, "embanked, converted into large reservoirs for fish and irrigation, and multiplied in number." Dr. Jackson evidently speaks of surface water, whereas I look to the sub-soil water which in the village site sinks to the level of the surface water in the adjacent low lying bheel. I entirely agree with him as to how these bheels ought to be treated. In sub-para. 1, para. 381, he further writes:—"In many very low and moist localities on "the margins of bheels, and on annually inundated slowly "draining land, it is either absent or of mild intensity." By examining places and sites in the rains, from the water level we can clearly see whether they are elevated or not, but in the dry weather the unaided eye is not sufficient for this purpose. Marshes and lands similar to the Lincolnshire fens are not absolutely necessary for the production of intense malaria, neither are low lying undrained lands in every instance. Aikin writes:—"But although it has been observed that absolute "marshes do not always produce agues, yet it is generally "found that in districts where such paludal fevers abound, "the surface is porous, penetrable, and retentive of moisture, although it does not appear on the surface of the "ground; that the district had been at one time submerged; "and that it continued slowly but constantly to undergo "the process of desiccation: or while at certain seasons it "imbibes moisture from local or meteorological sources, at other "seasons it undergoes the drying process under intense solar "heat. Such are some of the most sickly and febriferous "districts in Europe, India, and America. For example, the "Maremma in Italy; the district of the Lakes near Varna, in

"Bulgaria; many districts in Burmah; many newly cleared "tracts in North America; and many parts in the south of "Spain. In most of these places the conditions of the surface "of the ground are very much alike. While no obvious "appearance of a marsh exists, the vigour of vegetation is "extreme, amphibious animals abound, of the batrachian kind, "plants and cephalapodous mollusca of notoriously marshy "regions find a habitat, and the rich alluvial soil is so imper-"fectly cultivated, that the process of vegetation is not ade-"quately exhausted, and a surface of humid ground is exposed "to the solar heat, and so exhales a material which exercises a "persistent deleterious influence on the human frame. It is "believed that the number of insects and some reptiles with "which a place abounds are more significant of its insalubrity "than almost any other circumstance; and that a mixture of "animal and vegetable matters undergoing decay gives rise to "miasms much more noxious than those resulting from vege-"table matter alone. Dr. Fergusson in *The Edinburgh Philo-"sophical Transactions, Vol. IX, p.* 273, was the first author who "clearly proved that the drying of all porous soils, from which "watery fluid readily evaporated, was the genuine source of "exhalations capable of producing the paludal fever; and that "the febriferous activity of these exhalations was influenced by "the character of the season, the moisture, the temperature, "and the aërial movements of the atmosphere. The evidence "regarding the geological nature of soil as a cause of ague is "somewhat conflicting. It is a fact that the usual localities in "which paludal fevers abound are those in which the soil consists "of mineral, vegetable, and animal matters, mixed together in "such proportions and of such constituents chemically, as tend "to absorb moisture and retain it, and subsequently to decom-"pose. Such soils are known as *alluvial.* Paludal fevers "abound, however, where soils of a different nature predomi-

"nate. Level plains of sand, or dry, loose, open gravel, are soils "where malarial fevers have prevailed.

"The first time I saw intermittent and remittent fever become "epidemic in an army," writes Dr. Fergusson, "was in 1794, "when, after a very dry and hot summer, our troops in the "month of August took up an encampment at Rosendaal in "South Holland. The soil was a level plain of sand, with "perfectly dry surface, where no vegetation existed or *could* "exist, but stunted heath plants. On digging, it was univer-"sally found percolated with water to within a few inches of "the surface, which so far from being at all putrid, was perfectly "potable in all the wells of the camp." (Aitkin, Vol. I, pp. 510—511. Fifth Edition.)

We all know that the villagers dam *khals* and *nullahs* in order to flood their rice fields, but this is done to a limited extent on the low lands, and only for a time. Having the fields under surface water is a different thing from having the higher porous sub-soils water-logged to the surface, and this rising and falling according to, or in consequence of, neighbouring physical conditions. So long as a rice field is under water it is healthy, but during the drying process, which goes on gradually, it is to a certain extent unhealthy. A porous non-rice soil, subject to high elevation of, and sudden falls in its sub-soil water, under a tropical sun, is most unhealthy, or even deadly.

The following question is repeatedly asked:—*Why did the fever travel westward, and south-westward in Burdwan; north-westward to Birbhum, on to the laterite soils and dry lands, and why did it not extend beyond them?*

Because the fever did travel from east to west in Burdwan, it was considered contagious. That it did travel westward, and not south to Calcutta, Barrackpore, Howrah, &c., before it entered the Burdwan district, shows I believe that it was not a contagious fever.

The general drainage of the Burdwan district is from west to east. In the north it goes north-east, in the centre it goes eastward, in the south it goes south-east, except where it goes south-west into the Dalkissur. I said before that the big rivers in the north, east, and south really obstruct the drainage of the district. It appears from all the evidence that we can collect, that these rivers have changed very much within the last thirty or forty years, and are still changing. In many places they are obstructed where they were formerly free and open. Owing to changes which have taken place—and are still going on—in the Gangetic delta, the rivers in the west have changed their courses and gone to the eastward, while those in the east have gone to the westward, both tending, as it were to a central dip. Any changes taking place in the course of a river which produce an alteration or difference in the high water level must affect the tributaries of the river.* The changes in the big rivers are communicated to the *khals*, *nullahs*, and streams flowing into them, first at their mouths, and subsequently along the *khals* far in country. Swift, onward currents excavate, but back-water and stagnation from obstruction or pressure produce silt at these points of stagnation, and at the openings of the affluent streams. Each succeeding year adds to the changes and silting process, until at last the stream leaves its old course, and makes a new bed in another part of the country. The silted up *Sapjolar-khal* in Burdwan is an instance. As these changes in the rivers in the district have occurred from east to west, I think it is only reasonable to infer that the course of a fever following, or caused by them, should be also from east to west. The extension to Birbhum was from the Adjye river and the malaria-producing tract along its banks. The extension to the laterite soils in Burdwan was from the Dalkissur river towards Jehanabad. The extension in Midnapore was a natural one along and between the rivers. It is said that the fever was very deadly on the laterite and high lands in the Birbhum district. Dr. Jackson says that they suffered more than the low or moist lands. I do not know anything about Birbhum, but I take the following description of these villages from the Civil Surgeon's report:—" Some of the villages, where " the fever was severe and mortality excessive, are built on a " fine sloping plateau of laterite from 10 to 15 feet above the " surrounding country. The general lay of land in these places " is undulating, and almost free from vegetation, in fact, trees " are seen only in or near villages." Dr. Jackson in para. 381, sub-para. 4, thus writes about the fever:—" It travels, and not in the direction of the prevailing wind, but of the traffic lines." I am inclined to doubt the correctness of this conclusion. First, we have fever raging in the north of Burdwan to the south and south-east of these laterite villages some years before they were attacked. The tract along the Adjye was evidently a malaria-producing one. Secondly, the prevailing wind in Burdwan is south-east in July and August, and south in September, October, and part of November,—*i.e.*, in those months during which these places suffered from fever. Thirdly, in 1874, there was a considerable improvement in the fever tracts, a diminished supply (we may say) of malaria, and these villages did not suffer. From the description of the country it is quite clear that they were fully exposed to the influence of the malaria brought up by the south and south-east wind. This prevailing wind may also account for many of the outbreaks in the Burdwan district. In the west, beyond these villages, we come to still higher laterite ground and tree jungle, and the fever stops there. The high land and the jungle near Sonamukhi stopped the spread of the fever in this direction. The entrance (more properly the emergence) of the Dalkissur into the laterite, and tree jungle stopped the fever along its banks from Bamooneah to Bankura. The high level of the country stopped it along the Damoodah banks from Kushba northwards. In the north of this district the high laterite soil and tree jungle to the west of Kalicapore on the Adjye river, also stopped its progress in this direction. I believe that the malaria was not produced on these high lands and laterite soils, but that it extended to these places from the malaria-producing tract, chiefly perhaps by the aid of the prevailing south wind. Because it was deadly on these high lands, it was also assumed to be non-malarious. Here is what Aitkin says:—" High grounds near exposed marshes are often more " unhealthy than the places immediately adjoining, which are " on a level with them. Rocky places, such as Cindad Rodrigo, " Gibraltar, and Malaga have now and then been ravaged by " epidemics of littoral and paludal fevers; and the rocky shores " and islands of the Mediteranean—for instance, Minorca, Sar- " dinia, Sicily, Cephalonia, and all the Cyclades—abound as " much in these fevers as the most level parts of Holland; and " the West India Islands, most of which, although coralline " rocks, are the native soil of these diseases. Soil composed of " tenacious or stiff clay (argillaceous) is highly retentive of " moisture, and is difficult either to dry or to drain. The basin " of the Thames, comprehending Middlesex, Essex, Surrey, and " Kent, is almost entirely clay land, and is the district of Eng- " land, where agues most of all prevail, especially along the " banks of the Medway and the Thames."

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* Of course owing to physical phases, such as elevations of soils in certain localities and depressions in others, the tributaries all along a river are not affected in the same proportion or to a like extent.

This shows that it is not necessary for " the fens to be discoverable," as Dr. Jackson asserts.

The next questions are—

Why does the fever die out in some places, and why is it now apparently dying out in Burdwan?

By this dying out, we are not to assume that after a certain number of years, the village returns to its former healthy state. There is no such thing as this dying out. Chronic diseases, or the sequelæ of the fever remain for many years after the cessation of the severe type of fever. During last rains I visited Purbustholi, where the fever first (1862) broke out, and was very much disappointed by finding considerable sickness in the place, although the villagers have long since ceased to complain. There were a good many cases of fever, and 30·41 per cent. of the children had spleen. In Satgatchia, where there had been a lull for three years, the fever again broke out in 1874, and 54·17 per cent. of the children were suffering from spleen. In Nundhanhat (Purbustholi Thana) 15·23 per cent., in Makshimpara 13·72 per cent., and in Manikhar (Culna) 24·76 per cent. of the children had spleen. These places have been described as those in which the fever "has passed and gone." We have not, I am afraid, arrived as yet at that point of knowledge, which would enable us distinctly and clearly to point out why malarious fevers become epidemic at one time, and endemic at another. Aitkin writes:—"A season of excessive drought ensues, in "which solar desiccation and a little wind form conspicuous "characters; fever appears, and spreads at first slowly and "gradually, but afterwards, springing up in many points, rapidly "coalesces; and in a short time is so general and fatal "that it assumes an epidemic character. The usual mortality in "the meantime takes place; all the susceptible and predisposed "subjects pass through the disease or are cut off; and the "population of the place is once more reduced to its state of "epidemic insusceptibility and endemic or ordinary liability." He also writes:—"That paludal diseases, like many diseases "produced by morbid poisons, are annually endemic, and only "occasionally epidemic, is unquestionable. A few years ago "intermittent fever was epidemic in particular districts in this "country; but of late years the cases of ague have been comparatively rare. In Demerara it has been observed that "malarious yellow fever is epidemic about every seventh year. "At Gibraltar, although sporadic cases of paludal fever occur "annually, still malarious yellow fever is only occasionally "epidemic, but so irregularly that it assumed that character in "1804, then in 1810, again in 1813, and in 1814, and from that "period the garrison suffered no similar visitation until 1828. "The physical causes on which this greater virulence and greater "spread of the disease depend, are not determined."

Why sickness has prevailed for so long a time, and to such an extent in Burdwan town, Jehanabad, Munglecote, &c., is, probably, owing to the fact that these places were densely populated, and the people for years lived under the most insanitary conditions, or those most unfavourable to health.

Although the fever has now considerably abated, and exclusive Government aid is no longer necessary or advisable, yet I do not believe that we have seen the last of the Burdwan Fever. It will appear again, and, in fact, does annually appear in many villages in other districts in Bengal, *for it is nothing more than an exaggeration, or intense type of the ordinary endemic fever in Lower Bengal, which, at certain times, and under certain conditions, becomes epidemic and deadly.*

I shall now place, side by side, Dr. Jackson's observations and conclusions, based upon his dry weather tours and investigations, and mine based upon those made in both dry and wet seasons.

Dr. Jackson writes, page 80:—"If the district where the fever prevails be undergoing gradual conversion into the condition of Lincolnshire fens of many years ago, with a sub-soil water-logged, and exhaling marsh poisons for the population to absorb:"

(Dr. Jackson.)	(Remarks.)
(1.) "The fens should be discoverable."	Fens, in the sense understood, are not necessary. We have a porous soil, water-logged, or swamped nearly to its surface, subject to *sudden* and *rapid* changes in the rising and falling of the sub-soil water, and great

	evaporation from the ground at certain times. The rapid subsidence of this water beneath a hot sun are conditions under which a fatal or severe type of fever is apparently produced.
(2.) "The water-logged sub-soil should be demonstrable."	(2.) When the rivers are full or high, the water-logged sub-soil, in its true sense, is demonstrable. In the dry weather, particularly in villages close to the big rivers, except at a very considerable distance from the surface, it cannot be found, and hence, *at this season*, they appear to be high, dry, and well drained.
(3.) "The fever should be limited to, or most intense on, the worst drained sites."	(3.) Not necessarily, see *ante*, page ~~401~~ 61, quotation from Professor Aitkin. The fever on the high lands may be accounted for by the prevailing wind and a combination of circumstances. The same occurrences were also observed in by-gone years in different other places. The fever in the low lands was worst along the rivers, *khals*, &c. *The rice fields have not been set down as a cause of the epidemic.*
(4.) "The outbreak of fever should be gradual, like the 'conversion,' not sudden."	(4.) The reports by Dr. Jackson and all other observers show, that, with few exceptions, the fever has been gradual and mild in the first or second year, and severe or fatal in the second or third.
(5.) "It should, wherever it prevails, in the absence of drainage operations, continue, and not die out."	(5.) The dying out process is a very gradual one, and it takes very many years, during which there is considerable mortality from the sequelæ of the fever, before the village returns to a healthy state. The population then has been considerably reduced, and a state of "epidemic insusceptibility" is produced. Similar occurrencs have been observed before now.

(6.) "The inhabitants of these fenny tracts should present the well known characteristics of persons living in marshy lands."	(6.) Like all other districts in Bengal, Burdwan has always suffered from a certain amount of ordinary malarious fever. The epidemic was not produced by fens or marshes. We have seen before, that the outbreaks were gradual in first or second year, and then the people became unhealthy. Although, before the appearance of the outbreak they were healthy looking, yet, after it occurred, or had declined, the inhabitants in every instance presented the well known characteristics or appearances of persons living in malarious marshy lands.

Here Dr. Jackson states that "not one of these propositions is true of Burdwan." In para. 381 he writes:—"This fever, then, differs from simple malarious fever in the following points:"—

(Dr. Jackson.)	(Remarks.)
(1.) "It is not most intense in moist and low-lying localities. It is as bad on the top of a laterite mound, or on a dry elevated ridge, as anywhere. In many very low and moist localities, on the margins of bheels, and on annually inundated slowly draining land, it is either absent or of mild intensity."	(1.) In the cases of undoubted paludal fever in other countries, exactly the same observations have been made. See *ante*, page 401, for 61 instances, and previous remark, No. 3. I have before shown that, owing to better drainage, the villages in the vicinity of bheels are generally healthy. Annually inundated slowly drying land is not that which produces the severe type of malarious fever. For the conditions which produce this type, see previous remark, No. 1.
(2.) "The attacks are generally in the day time."	(2.) I do not see what this goes to prove. A man may be poisoned by malaria during the night or day, and still get his attacks during the day. Most poisons, including drugs, if given at night, produce their effects in the day time. The vacil-

lations in temperature, observed in typhus and enteric, occur in the day time. The attacks of fever are, however, not always in the day time. See page 382 for quotation from Dr. Jackson's report, para. 244.

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(3.) "Persons living in upper-storied houses are just as subject to the disease as those living near the ground."

(3.) We can hardly say that they were "just as subject," because we could never find out what the proportion was, or how they were affected. We know that in a fever-stricken village, those in upper stories did suffer, but with an intense evolution or advent of malaria poison prostrating nearly the whole of the villagers, it was not likely that some 20 or 30 feet would protect persons. I have my doubts that people so situated did suffer in the same proportion as others did. In one or two places, I found that the inhabitants had deserted their houses, although at first I was informed that they had all died.

(4.) "It travels, and not in the direction of the prevailing wind, but of the traffic lines. Its first march in Burdwan was westward; in the north its march was arrested by nullahs too narrow to stop malaria, so far as we know, by absence of intercourse, and scanty population.

(4.) These conclusions have been controverted in the body of this paper. In the rainy and fever season traffic is carried on by water, and not by roads. It did not extend northwards along the Bhaugiruttee to Cutwa or above it; north-west, along Damoodah, beyond Kushba; or along Dalkissur, beyond Bamooneah; or along Adjye, beyond Kalikapore. Had river traffic been the cause of the extension, it would have done so. It never extended along Grand Trunk Road—the great traffic line of this and adjoining districts. It is most probable that the prevailing wind brought it to villages in Birbhum and West Burdwan. Malarious fevers have always thrown out lateral extensions. Its first march in Burdwan was along

Bhaugiruttee river; then westward and south-westward; then along Damoodah, Dalkissur, the main *khals*, and Adjye—sending out lateral extensions from these foci. In the north, the progress was arrested by good drainage. The same result followed the same cause in the centre or east-centre, and in the west and north-west.

After carefully considering all the evidence for and against the disputed points in connection with this fever, and from my own observations, investigations, and enquiries, I believe:—

(*a.*) That the "Burdwan Fever" was a purely malarious or paludal one, without any typhus element in it.

(*b.*) That as its course and symptoms are different and distinct from enteric and relapsing fevers, these diseases may be omitted in the discussion, and dismissed from our minds.

(*c.*) That it was not contagious.

(*d.*) That its course was not along roads or traffic lines, but chiefly along rivers, *khals*, or streams, sending out lateral extensions from the malaria-producing places.

(*e.*) That when it attacked a village, it was, as a rule, mild or slight in first or second year, and that in subsequent years it was severe or fatal.

(*f.*) That after raging for an uncertain number of years, it gradually declines or abates.

(*g.*) That the fatal type of fever is preceded and followed by the appearance of an unusual number of ague cases, and mild remittents.

(*h.*) That the sequelæ of this fever are those of paludal fever, and of no other.

(*i.*) That the bad cases which recover in nearly every instance, suffer from *recurrences* of remittent and ague fever.

(*j.*) That the dying out process in a village is very gradual, and not sudden; and that it takes many years before a fever-stricken place returns to its former healthy state.

(*k.*) That generally the period of outbreaks is from July to end of November.

(*l.*) That it has travelled in opposition to the natural drainage course of the district.

(*m.*) That it has been caused by pent-up sub-soil water, which in a porous soil is, at certain times, subject to high elevations, and rapid retrocessions. These changes taking place beneath a hot sun appear to be the conditions under which malaria in its most intense or concentrated form is produced.

(*n.*) That this pent-up sub-soil water is caused by bad drainage, which has resulted from gradual and progressive changes in the rivers, *khals*, *nullahs*, or streams.

(*o.*) That those places in Burdwan which are better drained than others, have suffered very little from the fever, or have altogther escaped it.

(*p.*) That owing to better drainage those villages adjacent to low lying *bheels*, or small lakes, are, as a rule, found to be comparatively healthy.

(*q.*) That the extension of the fever to the high lands and laterite soils was a lateral one, wafted thither by the prevailing wind from a neighbouring malaria-producing tract.

If Engineering knowledge and skill be now invoked, Burdwan, being so well known, ought to be the battlefield of science against malaria; and possibly improvements in certain directions, by reopening the silted-up *khals*, clearing or deepening others, or by cutting canals in order to afford a more ready outlet to the pent-up waters, may eradicate the production of the poison in many places.

Note.—I may here state that Surgeon D. Wilkie, M.B., was deputed in April 1874 to investigate the nature and causes of this fever.

Unfortunately, while I was out in the district on famine duty for five months, he had to carry on my office and current professional duties, and in consequence he had hardly any time for his own investigations. By placing at his disposal all the documents I could get, and giving all the information in my power, I tried to assist him in every way I could; but although I knew him to be too good a man to be biassed by opinions or reports, I refrained as much as possible from discussing theories or fever matters. I wished him to be quite independent, to make his own enquiries, and to follow out his own investigations.

He wrote a report, which from his pen must be valuable, and to which I am looking forward, but I never read it, nor questioned him upon it. I am sorry that he could not have remained for another year in Burdwan, and that he was not there in 1872 or 1873.

ENDEMIC FEVER IN LOWER BENGAL,

COMMONLY CALLED

"BURDWAN FEVER."

BY

SURGEON-MAJOR JOHN GAY FRENCH,
M.D. & F.R.C.S., LOND. (EXAM.)
FIRST RESIDENT SURGEON, GENERAL HOSPITAL, CALCUTTA;
LATE CIVIL SURGEON OF BURDWAN.

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